

America's Desert Legion



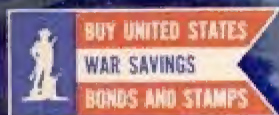
POPULAR MECHANICS MAGAZINE

WRITTEN SO YOU CAN UNDERSTAND IT

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SEE PAGE 27

BUY
WAR BONDS
AND STAMPS
TODAY
Keep America
Live



Nice goin', baby!"

First in the automotive industry to fly the Navy "E" with three stars, Fisher has also been awarded the Army-Navy "E" for its ahead-of-schedule tank production.

SO it goes, on a dozen fronts — American industry backing up American men with fire-power, with a rising flood of war tools and transport, with a heightening volume of all kinds of ordnance.

The Fisher contribution to this effort, in terms of volume, is huge. But volume alone fails to tell the whole story of the Fisher effort. For the long-acquired skills of the Fisher craftsmen are today playing a part of national importance. They have a vital and specific value of their own.

Our country's leaders realize that it takes precision men to do a job precisely — that extreme standards of mathematical exactness must be met in order to surpass the technical excellence of our enemy's war machines. And Fisher, as a

precision center, has been honored with a number of very difficult assignments.

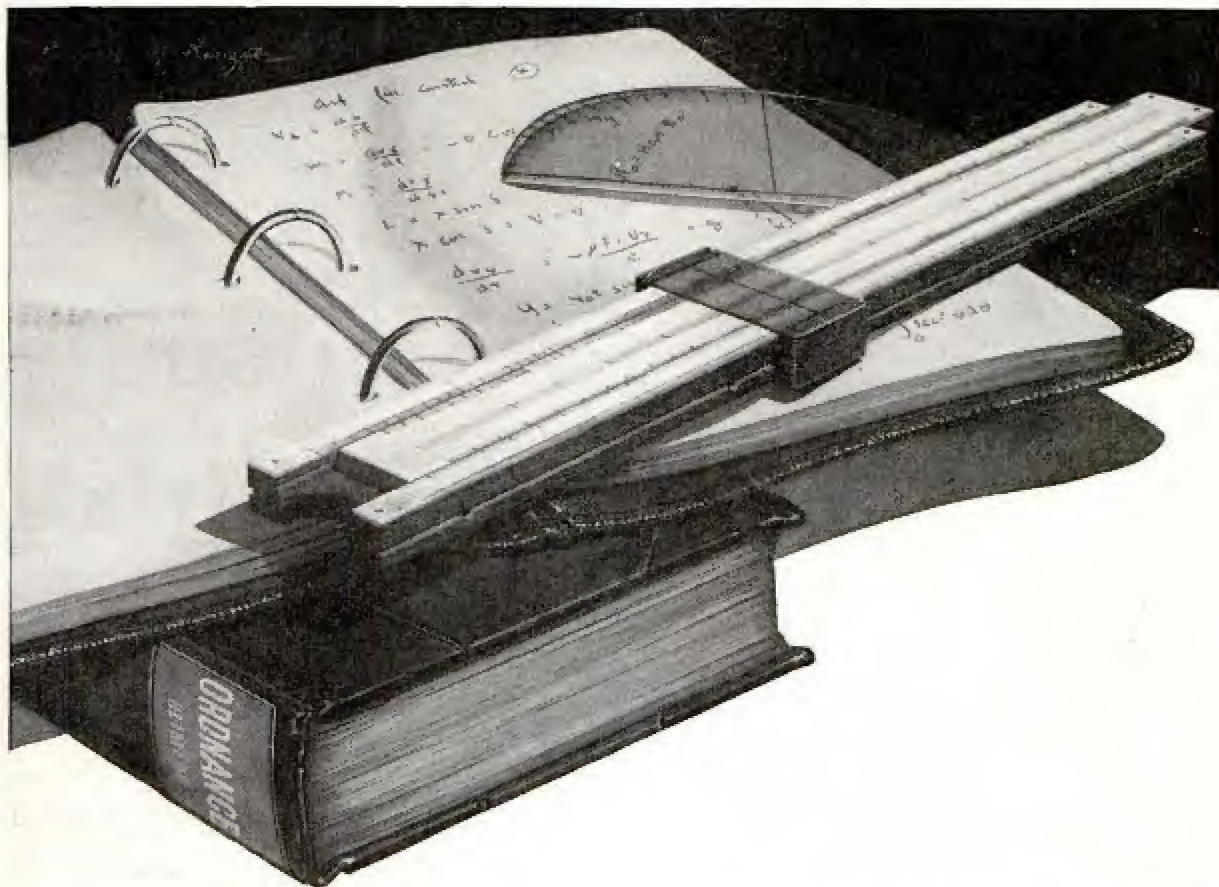
Our fighting men are doing the big job. But the vicious snick of our well-turned breech-blocks, the roar of our tanks, the bark of our anti-aircraft guns are music to their ears.



armament
BOXY BY

Fisher

D I V I S I O N O F G E N E R A L M O T O R S



What's a cotangent got to do with ack-ack?

PLENTY. So have sines, cosines, squares and square roots, differential equations, and integral calculus.

For the accurate firing of anti-aircraft batteries depends wholly upon the science of mathematical calculations that must be made fast—faster than a score of the most brilliant mathematicians could do it!

To solve these problems—to make the ack-ack of the United Nations deadlier—Westinghouse engineers are assisting in the development of an improved “electric brain” that

makes the necessary lightning-like calculations.

The firing control—known as the “computing director”—not only *locates* the exact position of the target as it twists and dodges through the sky. It also *calculates* where the enemy plane will be by the time the shell has traveled 10,000 or more feet into the air—all in a matter of seconds.

And that's not all. The computing director makes instantaneous corrections for drift, air density, wind conditions, and gun-muzzle velocity. In

addition, it calculates the fuse setting on the shell—so that the burst will occur at the *calculated position* of the enemy plane.

Westinghouse is making hundreds of other weapons for victory such as: guns, shells, radio equipment, instruments, electric motors and generators, and propulsion equipment for our giant battleships and rapidly growing merchant marine. And delivering these war materials faster than ever!

We are proud of the way Westinghouse “know-how” is adding day-by-day to America's tremendous striking power—on land, at sea, and in the air.

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Takes a lot of pulling together to do this and we appreciate the help from your end of the line.

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Popular Mechanics Magazine

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H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

June, 1943

Vol. 79, No. 6

Next Month

FITTING a few million truck drivers and lawyers, tea tasters, piccolo players and bankers into just the right one of some 2,000 specialized jobs in the U. S. Army is, to put it mildly, rather a large assignment. But the experts under the adjutant general's office are doing such a bang-up job of classifying men according to their aptitudes that the chances are 20 to 1 a rookie will gravitate into the particular service for which he is best fitted. A July article, "Uncle Sam Picks an All-Star Team," not only tells how it's done, but gives the reader a sample of aptitude tests similar to those used by the Army.

Molding a World

THERE is a bright new world in the making, and plastics will have a major part in it. The industry that started with synthetic billiard balls and false teeth, and brought us an era that has been called "the renaissance of color," is completely immersed in the war just now. But afterward, as a feature next month discloses, you'll have waterproof plastic clothes, homes and cars, even nonbreakable plastic water pipes.

Wood Takes to Air

WHEN Tojo shed crocodile tears over poor America, forced to make planes of wood, they weren't his last tears. Britain's Mosquito planes, which flew to Berlin to interrupt a Goering speech, are touted as the world's fastest and they're made of wood. Uncle Sam has a dozen projects for wood planes that will be sensations. Read about them in July.

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"Commence Firing!"

BIGGEST naval gun on the seas is the 16-inch, and there are nine of them on every new battleship of the 45,000-ton Iowa class. Each gun weighs 125 tons and flings a 2,100-pound shell over 20 miles. One shot costs the taxpayers \$900 for the projectile and \$300 for powder, but it isn't wasted. By burning up millions of dollars in prewar practice, the U. S. Navy developed the sharpshootingest gunners in the world, as many a Japanese ship has learned. A special feature in the July issue, "Commence Firing!" tells the complex story of how a gun is fired in a sea battle.

Fighting the Pigboats

TOUGH babies, these Nazi submarines. Double-hulled, they have been known to get back to port with the conning tower blown off. But we are also getting tough. Our methods of fighting them are varied and ingenious. There are new anti-submarine boats, and "magic eyes" by which an airplane can spot a surfacing sub. Outsmarting the subs is the No. 1 Allied job today because successful invasion of Europe depends on licking the pigboats. Read what's new in submarine warfare next month.

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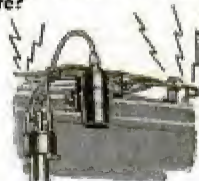
Important FACTS ABOUT YOUR CAR

Did you know that your car rusts faster now . . . picks up more moisture . . . corrodes easier . . . all because you are driving less these days?



... that accumulations of sludge, gum, dirt and other contaminations in the crankcase now become more a hazard than ever? That short, infrequent drives scarcely give lubricants time to warm up to a protective temperature?

... that wiring often "shorts" because of accumulated dampness . . . spark plugs become fouled . . . rings and valves stick, and power is otherwise hampered . . . due to the enforced idleness of your car?



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INCHES FROM DEATH, THEY WORKED LIKE FIENDS!

A true story of the blitz in England as told to a War Correspondent by Arthur Letts and Frederick Rourke, gas repair men for the Thames Estuary District, Greater London.



1 "The night sky was filled with enemy planes, and the earth shook with explosions. At the height of the raid we learned a bomb had smashed a gas main near the works. Rourke and I volunteered for the fixing job..."



2 "We found it," continued Rourke. "A big delayed action bomb sitting on a severed pipe in the middle of a three-foot crater. We set to work. Letts held the flashlight, taking care to shield it so the Nazis couldn't see it, while I blocked the broken pipe with clay."



3 "In about 12 minutes the job was done. They were the longest minutes we've ever lived. We couldn't have done it without our flashlight—and the steady light from fresh batteries you can depend on."

NOTE: Bomb Squad later dealt with time bomb. The George Medal for "extreme courage and devotion to duty" was awarded to Rourke and Letts.



OCD approved flashlight regulations stipulate careful shielding of the light from a flashlight during a blackout, as Arthur Letts did. Likewise wartime economy demands strict conservation of both flashlights and batteries. **Use your flashlight sparingly—save batteries! Don't buy a new flashlight unless the old one is beyond repair! Don't hoard flashlight batteries! Don't put in a more powerful bulb than your flashlight calls for—it simply wastes power!**

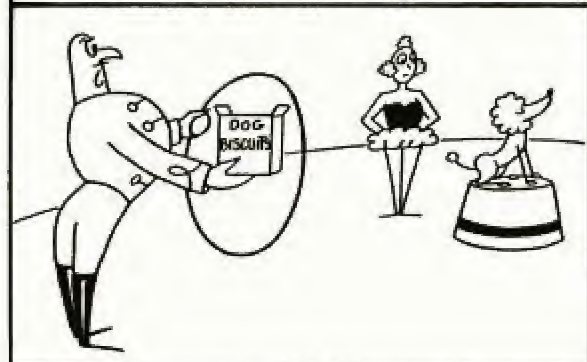
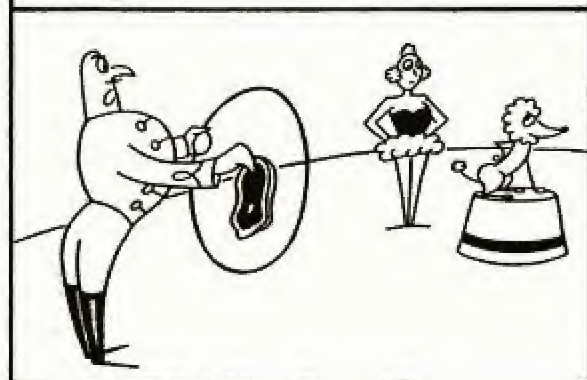
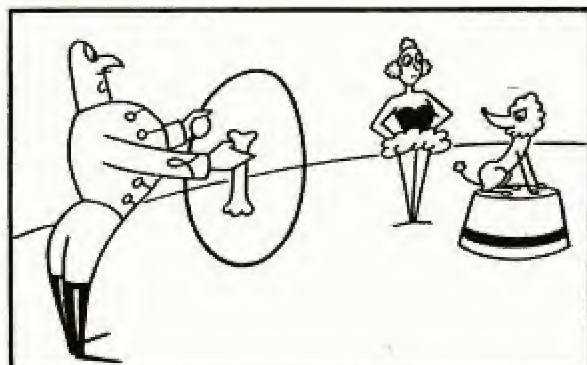
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IMPORTANT NOTICE

It is the intention of this magazine to provide its readers with information regarding the latest developments in the mechanical arts. We take no responsibility as to whether the disclosures contained in our articles are covered by patents and advise readers to investigate this subject before making, using, or selling any of the products, machines, or processes described in order to avoid possible liability for patent infringement.

"No, I Can't
Talk to
You..."



AN UNUSUAL TRUE STORY

**It May Have a Tip
for You**

"No, I can't talk to you. I am not interested in a correspondence course in Accounting and besides, I have a bowling date for tonight."

That's what our representative heard one day two years ago from a bright young man, high school graduate and bookkeeper for two years in a western city. Let's call him Jim, although that isn't his real name.

Just a month or so before, this same LaSalle representative had enrolled for the very same training another young man (let's call him Bert) recently arrived from Europe and then working as an office boy in the same town at \$15 a week. Bert worked enthusiastically, aggressively in his spare time on his study.

A year later our representative was asked, as they so often are, to recommend a successor to the chief accountant of Jim's company, a successor to the man under whom Jim worked. He recommended Bert and Bert was hired—as Jim's boss and at a salary considerably larger than Jim received. Four months later, Bert was made comptroller and given another salary increase.

A month later, Jim enrolled for the training which he had turned down a year before and he has since had a salary raise. He had been badly disappointed but he saw the point. He decided that he would not make the same mistake twice.

An Unusual Story—Yes

It doesn't often happen exactly as it did in this case. But in essence it does happen far more frequently than you suspect.

For business, when it has an opening, looks first to its own present employees to see who is ready and prepared for the job. But if, as so often happens, it finds no one, then it goes outside for the person it wants.

Don't blame the employer. Nine times out of ten, he would prefer a man or woman already experienced and familiar with company policies and methods. But he knows that long, loyal service in the job below may not be enough—he must have trained ability for the position.

That's why business watches its employees so eagerly—to see who is ambitiously and systematically preparing for promotion. We hear it over and over again—this note of gratitude when we tell an employer (as we do on request of any student) that some employee of his is training with us for better service to him.

Can It Happen to YOU?

There's only one way to be certain it cannot. That is to prepare yourself for the jobs ahead—for the place you want, either with your present company or some other. And quick action is particularly important in this critical period with so many changes and opportunities.

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- ☐ Internal Combustion Engines
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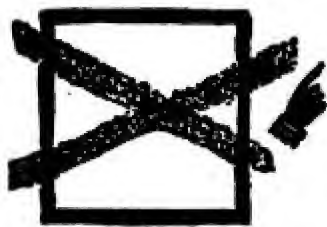
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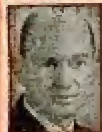
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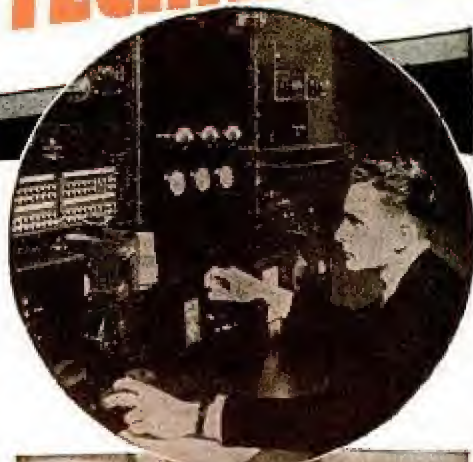
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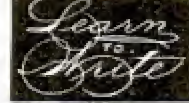
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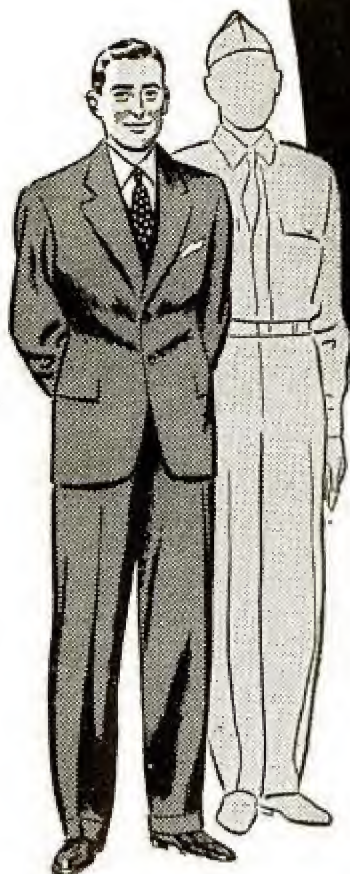
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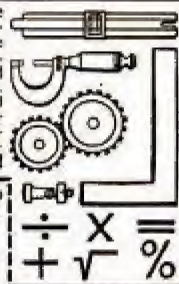
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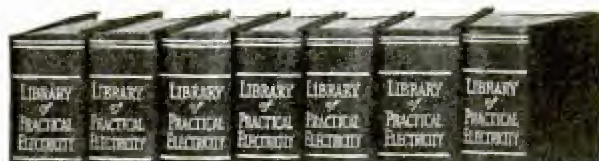
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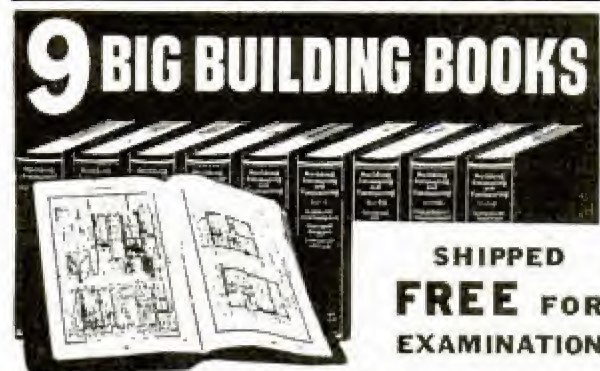
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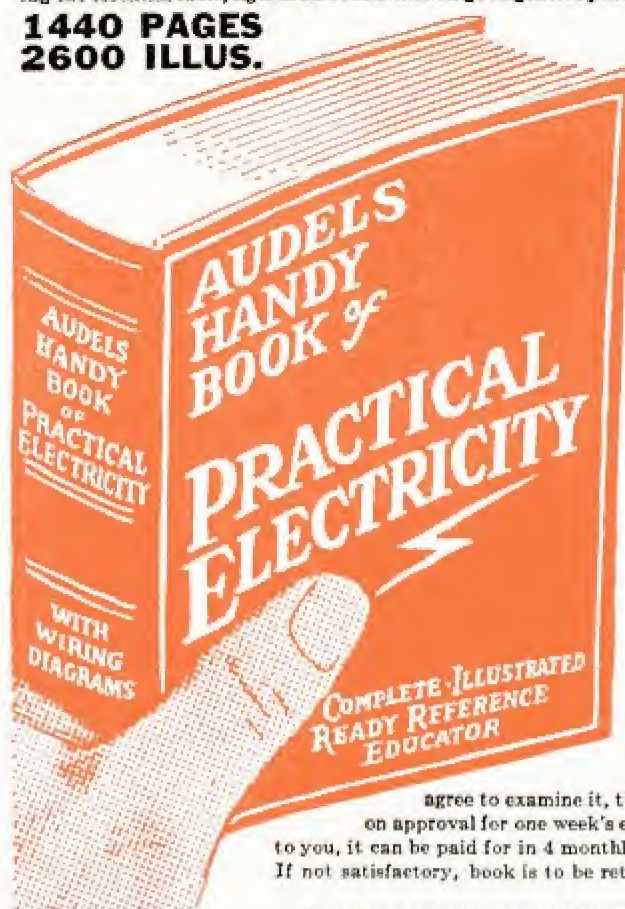
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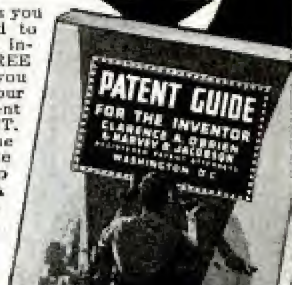
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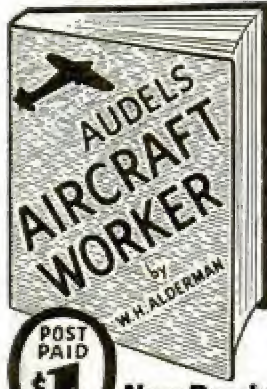
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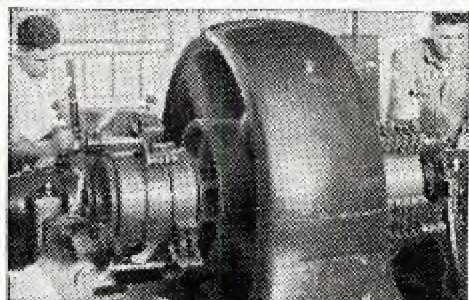


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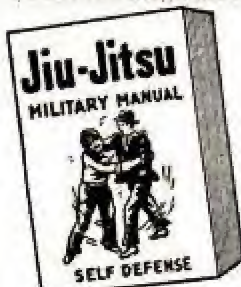
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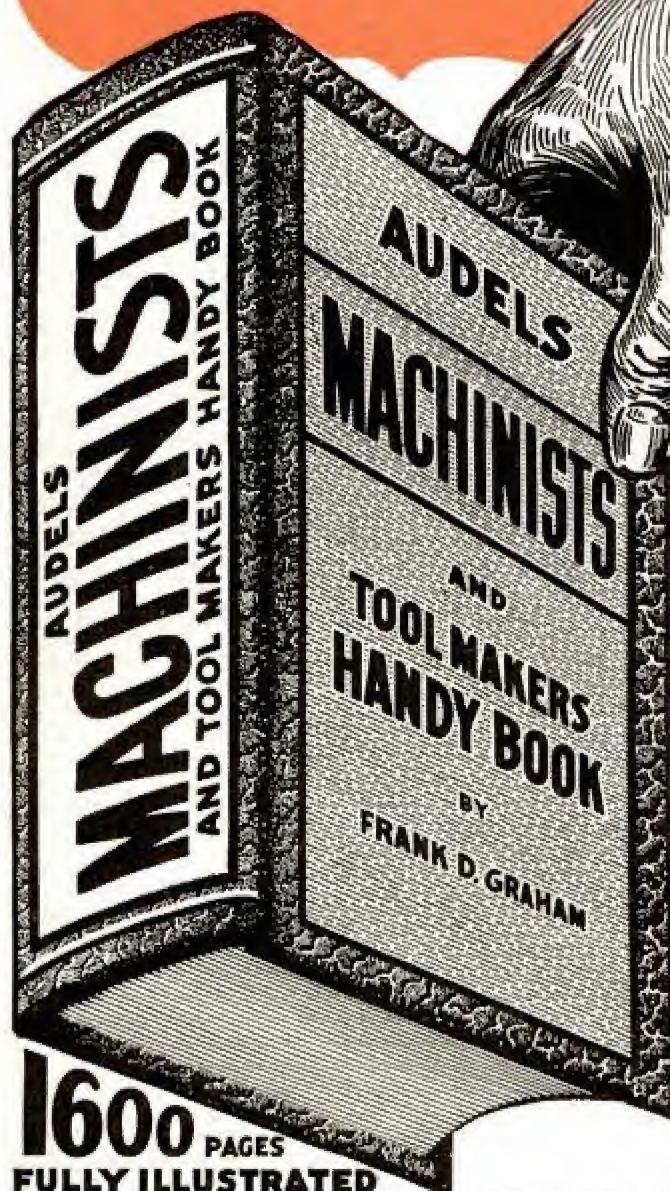
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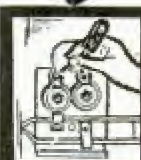
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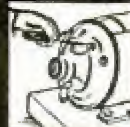
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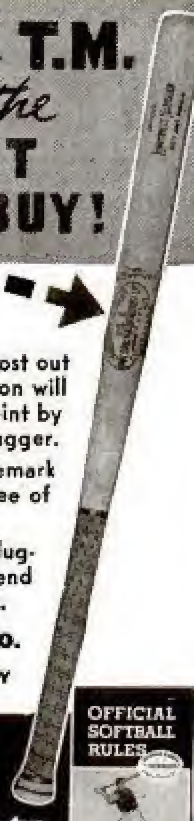
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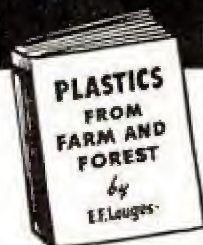
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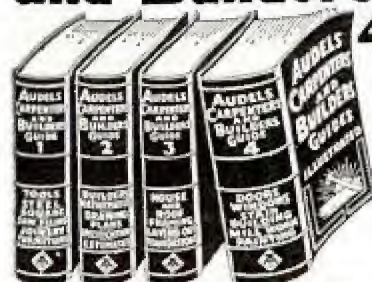
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REVISED Plans 18 long distance crystal sets, with "Radiobuilder"—year, 25c. Laboratories, 1406-C 77th Avenue, Oakland, California.

WANTED—Oscilloscopes, volt-ohm-milliammeters, vacuum-tube voltmeters—RCA, Hickok, Supreme, Precision, or equivalent makes. Hallcrafters SX28, SX25 receivers, Super Pro's and HRO's. Also 0-1 milliammeters and 0-5, 0-10, 0-25 a.c. or d.c. ammeters, 3-inch size. Idle test units and meters are needed for the war effort. Help train thousands of radio personnel by selling your equipment now. Send equipment for liberal appraisals to Allied Radio Corporation, Dept. 5X-P-3, 833 West Jackson Boulevard, Chicago.

KLADAG Radio Laboratories, Kent, Ohio, distributors since 1920, have thousands of parts, tubes, etc., unobtainable elsewhere. No catalog. Definite inquiry, enclosing return postage, gets immediate answer. \$25.00 list, new radio parts, some obsolete, all useable. collect express—\$5.00 cash, \$50.00 list—\$10.00.

CRYSTAL Radio experimenters. Write Hewlett, 29 East 39th, New York.

RADIO Communications courses qualifying for all federal licenses. Home study and resident courses. American Radio Institute, 44 East 43rd Street, New York, N. Y.

RADIO Service men and experimenters send for our giant radio catalogue. Save dollars. United Radio Co. (1000M), Newark, N. J.

BUSINESS OPPORTUNITIES

PROTECT Your post-war income. Start now by being the dignified owner of a route of postage stamp vending machines in your locality. Grocers, drug stores, gift shoppes, sweet shoppes, etc., are all live locations. This is not a penny catching scheme. \$500.00 cash will give you 20 machines, requiring about 4 hours of your spare time and net you \$18.00 to \$25.00 weekly. You may purchase any number machines you wish. Due to limited materials this offer may not last long. Write for particulars now. Osier, 15510 Springarden, Detroit, Mich.

HUSTLER Wanted! to introduce, supply demand for Rawleigh necessities. Good routes open nearby. Rawleigh methods get business. No selling experience needed to start. We supply sales, advertising literature—all you need. Profits should increase every month. Low prices; good values; complete service. Rawleigh Co., Dept. P-63-PPM, Freeport, Ill.

MAIL Order business course shows you how to make money, spare or fulltime. Teaches professional mail order technique—not penny-catching schemes. Free details. Nelson Company, 500 Sherman, Dept. P-402, Chicago.

START Home business making statuary, plaques, art goods, novelties, souvenir, concrete pottery, garden furniture, artificial marble flooring, liquid marble. Make your own flexible molds. Amazing profits. Valuable folder free. Creative Publishers, (PM6), Glencoe, Illinois.

PROFITABLE Business by mail. Small investment. Particulars free. Walker Herrin, 818S Vermont, Hannibal, Mo.

SELL Photostamps; 50% commission. Send for sample 6x9 imprint circular. Charles Russell, Box 2, Warren, Ohio.

START Spare time home business. Literature free. Morey Enterprises, North Chicago, Illinois.

AMAZINGLY Successful mailorder plan. Work at home. Pays well. Literature free. Leonard Publishers, 255-A West 93rd Street, New York, N. Y.

NEED Money? Sell books by mail. Write, Wolf's, 3240 Glenview St., Philadelphia, Penna.

SALESCARDS Your mailorder opportunity. Dime, Generalprint, Columbia St., Newark, N. J.

MECHANICALLY Inclined men—Own and operate general appliance repair shop. Complete, illustrated course shows you how. Welding, refrigeration, motor repair, how to get business, etc., all phases covered. Free literature. Christy Supply, Dept. 129, 2835 N. Central Ave., Chicago.

SELL Books by mail—Deal direct with publishers. Complete plan dime. Dixie Sales, King, North Carolina.

MAKE Your own Flexible Molds. Statuary, Art Goods, Novelties, Artificial Marble Flooring, Liquid Marble. Literature free. Kemico, 8-M, Park Ridge, Ill.

SUCCEED! Operate own business; home, office. 127 tested plans. Particulars free. General Sales, 149-A East 16th, New York.

COLLIER Explains how he made fortune in mailorder business. You may too, starting small. Literature free. Crown Books, Charlotte, Mich.

START Local or mail order business. Details free. Erickson, 20 Sturgis, Worcester, Mass.

START Your own magazine agency at home. No capital required. Write for particulars and supplies. American Readers' Service, Hatfield, Penna.

THE Army got me! My guaranteed gas-saver formula and wholesaling circulars \$1.00. I've made money. You can. Box 151, Beeville, Texas.

OWN And operate your own refrigeration repair shop. Complete, illustrated course shows you how. Free booklet. Highland School, Dept. P66, 1141 North Highland, Los Angeles.

PAY Cash for something to sell by mail. Box 844, St. Louis, Mo.

BIG Paying mail order business in your own home. Free literature. B. Matuska, Oirard, Illinois.

GUARANTEED Income! Grind lawn mowers. \$2.00 capital! Mowers, Janesville, Wis.

FREE—200 Clever mailorder, homework, local business offers—all snappy money-makers. Lewis Co., 828-M Carpenter, Oak Park, Illinois.

OPEN Cutrate drug store by mail. Complete plan dime. Dixie Service, King, N. Car.

UNUSUAL Opportunities, vitamins, plant hormones. Catalog accompanies Colchicine offer. See "Chemistry."

"HOW To Make Simple Molds and Plaster Plaques." No rubber required! Booklet 25c. Plastercraft, 1406 E. 43rd St., Cleveland, Ohio.

FOUR 3c Stamps mailed to: Clarence Goodwin Neal Publications, 6900 South Main Street, Los Angeles, California, will obtain America's greatest opportunity, in the mail order field. Only 1000 available, hurry.

CAPITAL Seekers—Interested in raising \$25,000 or more for a legitimate project should write to Amster Leonard, Fox Theater Bldg., Detroit, Michigan.

SIGNS And showcards easily and expertly painted with letter patterns. Many sizes and styles. Write for descriptive folder. John Rahn, A1330 Central Ave., Chicago.

INTERESTING Profitable mail order data free. Charles Hansen, Argo, Illinois.

MAKE Money at home in spare time by mail. Write Gordon Publishers, Box A23, Pawtucket, R. I.

YOU Can grow \$2,000 worth drug plants in your back yard. Box 731, Kellogg, Idaho.

INCREASE Your income. Successful mail order plan. Easy to operate. 800% profit. Never fails. Complete plan, ad copy unusual ideas only 25c. Jones, Box 126, Huntington Park, Calif.

PROFITS Without merchandise! 10,000-word course, \$2.00. Challenge Ass'n, Z-5, Cincinnati.

GOOD Paying business silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures, etc., by late method. No tanks or shop required, outfit furnished. Free sample. Gunmetal Co., Ave H, Decatur, Ill.

CHARTERS: Delaware; best, cheapest; free forms. Colonial Charter Co., Wilmington, Del.

ONLY \$1.00 Monthly or \$7.30 for whole year, pays for branch-office under your own name. Co-operative Offices, 126 Lexington Avenue, New York.

COLOR Cement with chemicals. Make artistic cement garden ornaments Hollywood style. Sample 10c. Hollywood Cementcraft, 8527 Wonderland, Hollywood, Calif.

VITAMINS, Minerals, health books, wholesale. National Diet Company, Portland, Oregon.

DRUNKENNESS Is a disease which responds to treatment. Medical skill plus human sympathy prove successful with liquor and drug cases. 60 years experience. Write for free booklet, P. M. Nelson, The Keeley Institute, Dwight, Ill.

AGENTS—To mail our literature. Good profits. Home business. Maywood, 1133 Broadway, New York.

5 MOST Read mail order magazines 20c. Armand Cartier, 695A North, Pittsfield, Mass.

WEBER Typewriter Mechanics School. Simplified homestudy-repairing increasing. Canton, Ohio.

STATUARY: Make all kinds. Simple process. Make and install artificial stone flooring in color. Liquid marble. Other money-makers. Write promptly. Literature free. Compo-Tex, Box 786, St. Louis, Mo.

PLASTEX Industries offers industrious men an opportunity to start a business of their own, manufacturing art goods, novelties, souvenirs, etc., in Plastex and marble imitation. Sc material makes \$1 articles. Rubber moulds furnished for speed production. Small investment brings good returns. We are now placing big chain store orders with manufacturers. Write for interesting booklet mailed free. Plastex Industries, Dept. A, 1085 Washington Ave., New York.

HOW And where to obtain capital. Fully explained, particulars free. Star Service, Wapakoneta, Ohio.

127 WAYS To make money, in home or office, business of your own. Full particulars free. Elite Co., 214 Grand St., New York.

LIQUID Marble—Colorful, glazed! Mold, brush, spray! Composition floors, rubber-lastic molds. Particulars free. Marbleizing Service, Edwardsville, Illinois.

400% PROFIT Selling 127 opportunities. Harris, Wall St., Phoenix, Arizona.

MONEYMAKING OPPORTUNITIES

MAGIC Money multiplier ideal! "Sturtevant's Story" tells all. Postal sent now brings "pointers." General Publications, Ossining, N. Y.

METALSTONE Solder. A flame resisting cooking utensil necessity. Simple to apply. Send quarter for sample and price list. Tom Osborne, 2119 N. 13 St., Omaha, Nebr.

PROFITABLE Homework. Particulars free. Woodcraft Projects, 1320 Lindsay, Gainesville, Texas.

DOLLARS in your mail! Write for attractive proposition. Coleman's, Smithboro, N. Y.

THOUSANDS Of articles wholesale. "Supply Source Directory" 10c. Ideal Service, D-6, Park Ridge, Ill.

GIANT Mails 6c; Mail Sale Magazine 3c. Opportunity mail free. Harvey Teeple, (PM) Decatur, Indiana.

SPARETIME Money-making opportunities. Free literature. Write Loren Hollenberg, Roseville, Ill.

HELP Win the war first! Then man, you'll like silvering mirrors, reflectors! Making sparkling chipped glass nameplates. Outfit prices. Sprinkle, Plater, V60, Marion, Indiana.

"FROG Raising!"—New book tells how! Free literature. Write today! Marlboro House, 1035-P Marlborough, Detroit, Mich.

MOLDMAKING—Plaster Casting. Complete formulas—fully illustrated. 25c. Ideal Service, RM-6, Park Ridge, Ill.

YOUR Name printed in 10,000 "Big Mail" directories. 25c. Checking copies sent. Arlesse's, 18881 Log Cabin, Detroit, Michigan.

MAMMOTH "Big mail." Samples, magazines, money-making opportunities, etc. 10c. Gant Publications, Parkersburg, West Va.

EARN Money evenings, copying and duplicating comic cartoons for advertisers. Adservice, Argyle, Wisconsin.

TIRED Of working for others? Be your own boss! Dimes, quarters, dollars by mail! Free particulars! Novel Enterprises, Dept. 1B, P.O. Box 457, Reno, Nev.

REAL Cash instead of promises! Rush dime for details newest and fastest selling line in mail order. E. Minnick Co., Timberville, Va.

DOLLARS, Quarters, dimes by mail! Stamp brings details. Colemans, Smithboro, N. Y.

EARN Money at home! Thousands do! "Home Worker Magazine" tells how. Sample, 25c. Sizemore, Box 7, 4917 North Kostner, Chicago.

LEARN Metascience. Remarkable drugless healing. No manipulation. No apparatus. Unbelievable simplicity and results. Inexpensive correspondence course. Write Metascience, De Land, Florida.

FORMULAS, PLANS, ETC.

AUTHENTIC Formulary 924 pages (illustrated), 10,000 money making formulas, recipes, instructions, substitutes, \$1.75 postpaid or C.O.D. (foreign \$2.10). Catalog, Adams Brown Company, Chestnut Hill, Massachusetts.

MAKE Fast selling products. No machinery. "Chemist Approved Formulas." Literature free. Kemico, 15, Park Ridge, Illinois.

FORMULAS For sale. Everyone of these new, different formulas is a money maker! A post card will bring you interesting details. A. Burk, 1788 East 2nd Street, Brooklyn, New York.

ICELESS Ice! Colder! Cleaner! Cheaper! Instruction, 25c. Duffy, A53, Covington, Ky.

"LUMINOUS Paint" shines in dark. Easily made. 100 other formulas, plans—all 25c. Ideal Service, 306, Park Ridge, Ill.

MOTOR Oil 1c gallon. Reclaim used oil for profit. Formula 25c. George, 5008 Stenton Ave., Philadelphia, Penna.

THE Latest formulas for factory, business, farm, home and workshop. Full particulars, free. Write, Warren White, 1300 Commerce, Dallas, Texas.

REAL Manufacturing formulas. Lists free. Cummings, Chemist, Gordon Ave., Syracuse, N. Y.

FORMULAS — Latest, best. Analysis. Literature free. Belfort, Engineering Building, Chicago.

CHEMISTRY

WINN'S New Idea Home Laboratory Chemical Kits and apparatus outfits for home experimenting. Send 6c for literature and retail supply catalogue. J. H. Winn Co., Dept. 506, 124 W. 23rd St., New York.

FREE Catalog: Chemistry, mineralogy, biology, optics. Tracey Laboratories, Evanston, Illinois.

COLCHICINE—Evolution chemical creates new mutant plants. Illustrated booklet—plus Experiments Magazine 25c. Questok, Wellesley, Mass.

CHEMICALS And laboratory apparatus. List free. Peerless Scientific Co., 184 W. Washington, Chicago, Ill.

CHEMISTRY Laboratory apparatus and chemicals for industrial, analytical, and private experimental laboratories. Complete chemical laboratory supply service for correspondence school students. Send 3c for free 48-page catalog of chemicals and apparatus. Dept. M-43, Biological Supply Co., 1176 Mt. Hope Ave., Rochester, New York.

SPECTROSCOPE For quick chemical analysis \$2.50. Kutting Sons, Campbell, California.

HELP WANTED

BIG Money taking orders; shirts, ties, hosiery, underwear, pants, jackets, sweaters, uniforms, etc. Sales equipment free. Experience unnecessary. Nimrod, 4922-AN Lincoln, Chicago.

AGENTS WANTED

START Your own business on our capital. Always your own boss. Hundreds average \$3,000 to \$5,000 annual sales year after year. We supply stocks, equipment on credit. 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant, profitable business backed by world wide industry. Write Hawleigh Co., Dept. F-U-PPM, Freeport, Ill.

"MAGIC Roach Box"—Handy, effective, economical. Carton twelve boxes \$1.00 post paid. Agents wanted. Nock Co., 1712 Valmont, New Orleans, La.

AMAZING Furniture polish; insecticides; other products; tremendous market; top commissions. U-needor Chemical Company, Des Moines, Iowa.

MOTO-PURR—New scientific tablet! Greatly increases gasoline mileage! Attractive counter display card sells to dealers. Your profit over 100%. Details free. Motor-Aids Company, 3338 Manderson, Omaha, Nebraska.

MINIATURE Bibles! Fast sellers! Literature free! H. Tooker, 630-K Chestnut, Hamilton, Ohio.

LUMINOUS Paint, profitable 50c seller. Details, Ward, 97C, Saybrook, Conn.

EASILY Sold. All tavern operators need it. Simplified tavern bookkeeping. Lasts one year. Sells at sight for \$3. Your cost \$1.50. Let's go! Jaysee Systems, 825 E. Bowman, So. Bend, Ind.

INSTANT Demonstration clinches sales. Sample 3c. "Felspar" Car Wax Ploss, Portland, Oregon.

MINISTERS Earn extra money. Wyss, 104½ Francis, St. Joseph, Mo.

DANDELION Death! Make-sell 1,500%. Other simplified, manufacturing processes. Wholesale prices, Thermoevaks, Peoria, Ill.

BIG Money taking orders; shirts, ties, hosiery, underwear, pants, jackets, sweaters, uniforms, etc. Sales equipment free. Experience unnecessary. Nimrod, 4922-AN Lincoln, Chicago.

CATHOLIC Men and women. Sell religious, patriotic pocket piece. Good profits. Send 25c in coin for sample and details. Religious Supply Center, Box 388, Dept. P, Attleboro, Mass.

SELL Birthday and everyday greeting cards. 4154P Fifth Street, Philadelphia.

COMMISSIONS, Salary, ladies' men's underwear, hosiery, slaps, shirts. National, 1299 Eastern Parkway, Brooklyn, N. Y.

WANTED Men to start business for themselves. We start you. Make \$1,000.00 month. Send stamped self-addressed envelope. Akron Rug Co., 5 N. Adam St., Akron, Ohio.

NOVELTIES, Service banners, flags, pennants, pillow tops, military jewelry. Retail or wholesale. Samples \$1.00. Clover Novelty Company, 101-M, Hollis, New York.

COUNTY Representatives wanted—Sensational 100% profit 50c seller Storm-Proof Cigarette-Cigar and Pipe Lighter, employing charcoal principle—"More wind blows—more lighter glows." Everybody wants one because everybody smokes. Fully guaranteed. Storm-Proof Lighter Company, 126 Lexington Avenue, New York.

OPEN Wholesale greeting card "supply depot" at home. No canvassing. Instructions free. Dunbar, New Brunswick, N. J.

AGENTS. Big line including food products. Fast selling premium and bargain deals. Low prices. Send card for big outfit offer with gift. Ho-Ro-Co, 2737 Dodder, St. Louis, Mo.

GOOD Paying business silvering mirrors, plating, autoparts, reflectors, bicycles, bathroom fixtures, etc., by late method. No tanks or shop required, outfit furnished. Free sample. Gunmetal Co., Ave. N, Decatur, Ill.

PLAYING Card game. 250% profit. Sample game 25c. Box 842, Denver, Colo.

GOLD Lacquered window sign letters. New styles. Absolutely beautiful. Free samples—catalogue. Atlas, 7941 Halsted, Chicago.

AGENTS—300% Profit selling gold leaf window letters; stores and offices. Free samples. Metallic Letter Co., 438-B North Clark, Chicago.

FREE Water and our concentrates, makes flavors, lotions, shampoos, 72 products, labels, bottles furnished. Qualco, E-20030 Russell, Detroit.

MAKE Money applying initials on automobiles. Also, sideline salesmen for short run decal name plates. "Ralco," 1483 Washington, Boston, Mass.

WHOLESALE Sources. 500,000 articles. Free directory. Maywoode, 1133 Broadway, New York.

ELITE Collection contains 127 plans for starting own business; home, office. Descriptive booklet free. Elite Co., 214 Grand St., New York.

SELL By mail! Books, novelties, bargains! Big profits! Particulars free! Elko, 438 North Wells, Chicago.

AGENTS: Stamping names on pocket-key protectors. Sample check with your name, address. 25c. Stamping outfits. Emblem checks, check-fobs, name plates. Hart Mfg. Co., 303 Degraw St., Brooklyn, N. Y.

SELL Amazing chemical that increases gasoline mileage. Big profits. Barkley, A-1316 Arch, Philadelphia, Penna.

DO You want agents for your proposition? Your ad in this space will place your message before hundreds of men seeking fast-selling products. My folder "How to Secure Agents," is filled with proof, I'll gladly send you a copy free. P. W. Johnson, Manager Classified Advertising, Popular Mechanics Magazine, 200 E. Ontario St., Chicago.

HIGH-GRADE SALESMEN

ADVERTISING Book matches. America's largest manufacturer of union label book matches. Fast selling line. Large sales producing kit. Sample matches. Complete cut catalog, 17 color combinations makes selling easy. Commission in advance. Superior Match Company, 7530 Greenwood, Dept. M-6, Chicago.

SALESMEN Selling large offices—unique proposition. Lewis Co., 413 W. State St., Milwaukee, Wis.

SALESMEN: Have real money making opening. Fits into war program. Old progressive firm. Dept. "P," Box 392, Dallas, Texas.

SALESMEN: Age 35-65; a sensational new money-making service for business firms; \$75-\$100 weekly commissions; no competition. 615-PM Finance Bldg., Kansas City, Mo.

PATENT Solicitor wanted—Part time work. Profitable, dignified profession. Exclusive territory. 27 years in business. No experience necessary. Write W.A.S., 332 Wells Building, Milwaukee.

EDUCATIONAL AND INSTRUCTION

LEARN To letter like an expert in 3 minutes! Make professional-looking signs, posters, maps, designs, etc. No experience needed! It's easy with Stenro Lettering Sets. Stenro is amazing new lettering guide widely approved by experts and beginners alike. Complete set, with three different size alphabets, numbers, dozens of graceful designs (U. S. flag included), plus big U. S. map showing all 48 states, only 50c at dime, stationery and department stores. If your dealer can't supply you, send only 50c today to Stenro Lettering Co., 2510A Elnor, Baltimore, Md.

LEARN To sing! Amazing, modern self-teaching course shows how. Revolutionary, short-cut methods that get quick results! Created by master teacher whose students have won fame and fortune. Inexpensive. Eye-opening literature free. Easyway Method, 1210-M No. 11th Terrace, Birmingham, Ala.

LEARN Blacksmith tempering. Copy-right booklet 50c. Leaflets 10c each. Smith's, P.O. Box 3095, Hollywood, Calif.

DRAFTING, Trigonometry, slide rule courses. Understandable. Reasonable. Inquire Giles, Box 1498-1, Burbank, Calif.

EXCEPTIONAL Opportunity. Operate a collection agency-credit bureau. Quickly learned. Many make \$5,000 yearly, up. Write Cole Associates, Syracuse, N. Y.

MATHEMATICS, Arithmetic, algebra, geometry, trigonometry. Mondell Institute, 230 West 41st, New York.

REFRIGERATION Course. Authentic. Completely illustrated. Free booklet. Highland Refrigeration, 1141 North Highland, Los Angeles.

HOME Study course, drugless therapy. Free literature. Inst. of Drugless Therapy, Tama, Iowa.

WELDING—Electric arc. Learn profitable trade quickly through actual practice. Individual welder instruction at bare cost of materials. Full particulars free. Valuable welding lessons book 50c. Hobart Welding School, Box M-632, Troy, Ohio.

EARN Certified Grapho-Analysis degree in amazing new science. Students report earning up to \$1.00 an hour spare time, \$75.00 weekly full time. Graduates in employment and credit agencies, police departments, hotels, theaters, department stores, courts, doctor's offices, private practice. Free placement service. 3,000 word illustrated lesson free. Alfa, Linn Creek, Mo.

SECRET Detectives make big money. Rewards. New training method. National Detective, Struthers, Ohio.

UNUSUAL Magazines, vitamins, plant hormones. Catalog accompanies Colchicine offer. See "Chemistry."

DETECTIVE Training. Phillips Secret Service, 1917-B North Kenneth, Chicago, Illinois.

BE A doctor. Learn chiropractic. Fast growing profession. Write for catalog. Texas Chiropractic College, San Pedro Park, San Antonio, Texas.

LEARN Crepe paper window decorating. Complete course \$1.00. J. P. O'Neill, Box 158, Parkland, Bucks County, Penna.

LEARN Jiu-Jitsu. Complete illustrated instructions 25c. Boxing 25c. Wrestling 25c. Joseph Dryer, 23 S. Halsted, Chicago.

POPULAR MECHANICS

NEW Writers wanted to re-write ideas in papers, magazines, books. Splendid opportunity to "break into" profitable writing field. Rush postcard for free details. Comfort Writer's Service, Dept. F-149, St. Louis, Mo.

SECRET Investigation. Experience unnecessary. Detective particulars free. George Wagner, M-125 West 86th, New York.

DRUNKENNESS is a disease which responds to treatment. Medical skill plus human sympathy prove successful with liquor and drug cases. 60 years experience. Write for free booklet. F. M. Nelson, The Keeley Institute, Dwight, Ill.

LOCKSMITH Course. Lock picking, key fitting, etc. \$1.00 prepaid. Locksmith, Canadian, Texas.

CLINICAL Laboratory technic taught in your own home. Practice outfit supplied. Bulletin free. Imperial Technical Institute, Box 973-E, Austin, Texas.

LEARN Telegraphy! Splendid opportunities now prevail. All expenses low. Catalog free. Dodge Institute, Dept. M, Valparaiso, Indiana.

RADIO Engineering, broadcasting, aviation and police radio, servicing, marine and Morse telegraphy taught thoroughly. All expenses low. Catalog free. Dodge Institute, Dept. R, Valparaiso, Ind.

LIBRARY of 1700 time and labor saving ideas for everyone who uses tools. Shop Notes for 1940, '41, '42, '43 \$1.95 per set. Popular Mechanics Press, (C-43), 200 E. Ontario, Chicago.

CARTOONING, COMMERCIAL ART, SHOWCARD WRITING, SIGN PAINTING

CARTOONING — Drawing; \$1.00 each course! Warren, Artist, N7509 Smith, Spokane, Wash.

AMAZING Cartoon plans, 225 markets, etc. Hartman, 2438 W. Lincoln, Nebraska.

ADVERTISING Artists, copywriters, printers, etc. Willis Studios, 5452 Iowa Street, Chicago.

CHALK Talk stunts. 20 patriotic, \$1.00. Catalog 10c. Balda The Cartoonist, Oshkosh, Wisconsin.

CARTOONING Course—30 illustrated lessons, over 500 sketches. \$1.00 postpaid. Montes Studio, Box 892, Pasadena, Calif.

EARN Money evenings, copying and duplicating comic cartoons for advertisers. Ad-Service, Argyle, Wisconsin.

STUDY Art cartooning. Book lists free. Box 592, Springfield, Ill.

BEST Complete cartoon course with artists kit—\$2.00. Membership Cartoonists Association free. Cartoon Publishers, West Springfield, Mass.

ADVERTISING AGENCIES, LETTER WRITERS, FOR ADVERTISERS

MAIL-ORDER Or agent ad reaching 1,000,000 families throughout United States \$15.40 inch. Newspaper, magazine, mailing-list, rate-book, free. Chicago Advertising Agency, 20-PM West Jackson, Chicago.

INCH (40 Words), 58 magazines \$1.50. Paramount Press, Atlanta, Mo.

MAIL Order sales skyrocketing. Cash producing ads, letters, folders, etc., prepared. Best pullers, lowest rates. Free analysis of your product. Van De Mark, Times Star Tower, Cincinnati.

MAIL Order advertising counsel. Martin Agency, 111RB Madison Avenue, New York.

ADVERTISE: 24 Words, 149 newspapers, \$6.50. Lists free. Advertising Bureau, 4515-C Cottage Grove, Chicago.

24 WORDS, 35 Newspapers \$2.00. Goodall, 37 Gardner, Vallejo, California.

ADVERTISING Placed all magazines, newspapers U.S.A., Canada. Lowest rates. Free service. 54-page catalog free. Baker Advertising Agency, A-189 W. Madison, Chicago.

FREE—New Advertisers Rate Guide. 44 pages. Includes everything. Lowest rates. E. H. Brown Advertising Agency, Merchandise Mart, Chicago.

FREE—"Amazing New Book"—"Profits From Classified Advertising." Tells how and what to advertise. Be sure to read this book before you invest one cent in advertising. Remember—It's free! Write for your copy now. F. W. Johnson, Classified Advertising Manager, 200 East Ontario Street, Chicago, Illinois.

BUSINESS SERVICE

NEW York City address—Business or personal mail received, forwarded, \$2.00 monthly. International, 17 East 48th Street.

CHICAGO Mail address: \$1 monthly—Receiving, forwarding your business, personal mail. General, 30 West Washington. (Established 1919.)

HAWKINS Mail Service, Washington, D. C., receives, re forwards, business, personal mail. \$2.00 monthly. No. 7d Randolph Place.

SAN FRANCISCO Mailing address \$1 month. Acme, Room 425, 85 Fourth St.

HAVE A mailing address down in Dixie. Receiving and forwarding, \$2 monthly. Azales Mailing System, 16 Le Moyne, Mobile, Alabama.

TYPEWRITERS, DUPLICATORS, OFFICE DEVICES

WANTED — Used typewriters, adding machines, every description. Broadway Typewriter Shop, 4312 Broadway, Chicago.

TYPEWRITERS. Adder, mimeograph, multigraph, addressograph. Send for free lists of machines that will help you at half price. Pruitt, 28 Pruitt Bldg., Chicago.

RUBBER STAMPS, OFFICE SUPPLIES

ONE Line 15c. 2 lines 25c. 3 lines 35c. Excello Sales, Dept. B, Box 500, Shreveport, Louisiana.

3 LINES 30c: Cushioned, indexed, 35c; signatures \$1.50. Stamprite, Wauwatosa, Wis.

BETTER. Cheaper, Quicker. 3 lines 35c. Mary Struble, Cupertino, California.

KNOB Handle, cushioned. 2 lines 30c. 3—40c. Stamp Works, Centerport, N. Y.

PRINTING, MULTIGRAPHING, MIMEOGRAPHING, GUMMED LABELS

MIMEOGRAPH 300 Postcards or 300 letters, \$1.00. Additional copies 10c per 100. Paper cost extra, include 15c for each hundred sheets. No lineage limit. Not prepaid. Dollar Letter, 180 W. Washington, Chicago.

500 ONE-COLOR Stickers, 25c. Job printing. Cott's, 433 Jackson, Chillicothe, Missouri.

1,000 LETTERHEADS Or envelopes \$2.95. Cuts. Kressman, Washington, New Jersey.

NEED Printing? Request quotations, stating quantity. Reasonable. Herald, Albany, Wis.

LETTERHEADS, Envelopes, Distinctively designed. Many type styles. Small quantities. Bargain prices. Graydon, Box S-4152, Denver, Colorado.

QUALITY Printing—Low prices. Send for new price list. Ray Specialty Service, 1009 Henry, Detroit, Michigan.

STUNNING Personal-social stationery. Aristocratic paper. Samples, prices, free. Cusack Stationer, Fulton, New York.

5c POSTAGE Brings samples of patriotic stationery, patriotic stickers and big mail. Virginia Burkhardt, 1228 St. Ferdinand, New Orleans, La.

1000 6 3/4" PRINTED Envelopes \$3.00. Good quality. 500—\$1.75. Robert Felton, Cupertino, California.

OFFSET Printing the modern method. Reproduce ruled forms, drawings, music, letters, envelopes. Modern Lithographing, Jefferson City, Missouri.

1000 BUSINESS Cards \$2.50. 250 letterheads or envelopes \$1.50 postpaid. Bob, 23-3-D, Heart Mtn., Wyo.

250—\$1.00: LETTERHEADS, Envelopes, statements. 500 1x2 labels 25c. Paramount Press, Atlanta, Mo.

\$1.00 POSTPAID: 100 8 1/2x11 Bond letterheads and 100 6 3/4" envelopes. Benneville, 907 West Roosevelt, Philadelphia.

PRESSLESS Printing, simplified cut-making, dozen printers' secrets, \$1.00. Challenge Ass'n, X-5, Cincinnati.

500 3x4" ATTRACTIVE Shipping labels \$1.10. Colorpress, 2025 Temple, Detroit.

LETTERPRESS And offset printing. Advertising Literature, 4154F Fifth Street, Philadelphia.

BETTER Grade printing reasonable. Estimates on anything. Economic Press, Leonia, N. J.

FOR The best in personal stationery printing write Box 5450—Metropolitan Station, Los Angeles, California.

SPECIAL! 200 Bond letterheads, envelopes, 89c. Samples. Joseph Johnson, 1382-A Fifth Ave., New York.

THOUSAND 6x9 Circulars; advertising cards, \$2.95. Samples. Reporter, Chelsea, Oklahoma.

DISTINCTIVE Variety printing. Exquisite color tone embossing. Varioprint, 36-A Woodbury St., Wilkes-Barre, Penna.

FIRST Quality printing. Reasonable. Samples. Treaster Printing Service, Milroy, Pennsylvania.

BETTER Printing—Folders, pricelists, anything, reasonable. White Publishers, Baraboo, Wis.

MIMEOGRAPHING—Letters, pricelists, formulas, instructions. Lowest prices. Lem's Letter Shop, 5710 Stanton, Detroit.

5000 ELEGANT Envelope slips, \$3.75; postcards, \$8.76; 6x9 circulars, \$8.25. All printing low prices. Samples. Goodprint, Harrisonburg, Va.

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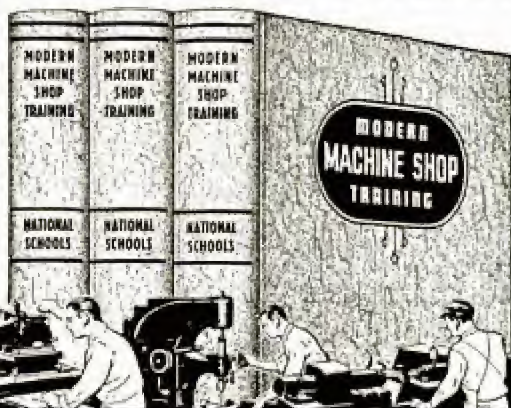
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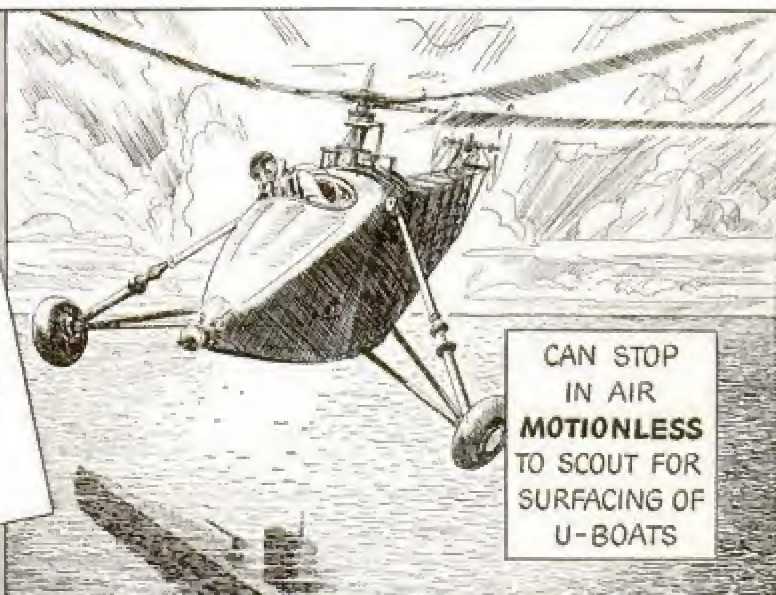
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WRITTEN SO YOU CAN UNDERSTAND IT

Vol. 79

JUNE, 1943

No. 6



Lockheed's four-engined Constellation, fast as it is vast, resembles a great winged shark

THE civilian aircraft warning observer wore a puzzled frown as he reached for the telephone. "Army Flash!" he barked, "One big four-motored plane bound east. Looks like a shark with a P-38 wing and a triple tail, and is going like sixty! Not on my identification chart!"

The observer had spotted the first flight of Lockheed's big "Constellation" and his description was pretty accurate. The plane's fuselage is cambered like an airfoil section, giving it a shark-like appearance. Its down-dipping nose caused Lockheed employees to name it unofficially "Old Loop Snoot." Among other advantages,

Milo Burcham, Lockheed engineering test pilot, familiarizes himself with the cockpit controls

The FLYING SHARK



JUNE, 1943

*Aircraft Corp
Burbank Calif.*



One engine can be removed and a new one installed in 45 minutes with these connections

the cambered nose saves weight by reducing the length of the nose wheel assembly of its tricycle landing gear.

Instead of being just one more large airplane, the Constellation is actually a small plane compared to the future sky giants that its design suggests. Transports of hundreds of tons gross weight are easier to anticipate now because the Constellation supplies the answers to a number of stumbling blocks that seemed characteristic of giant aircraft.

The new plane is faster than a Jap Zero fighter, though its weight is up in the range of the 82-ton B-19 bomber. It was designed to carry 55 passengers and a crew of nine across the United States nonstop in nine hours. Its 8,000 horsepower four-unit power plant consumes about one gallon of fuel per mile of travel, an economy that would allow it to carry 60 passengers from New York to Los Angeles at less than railroad rates, provided it made a few fuel stops.

Its normal nonstop

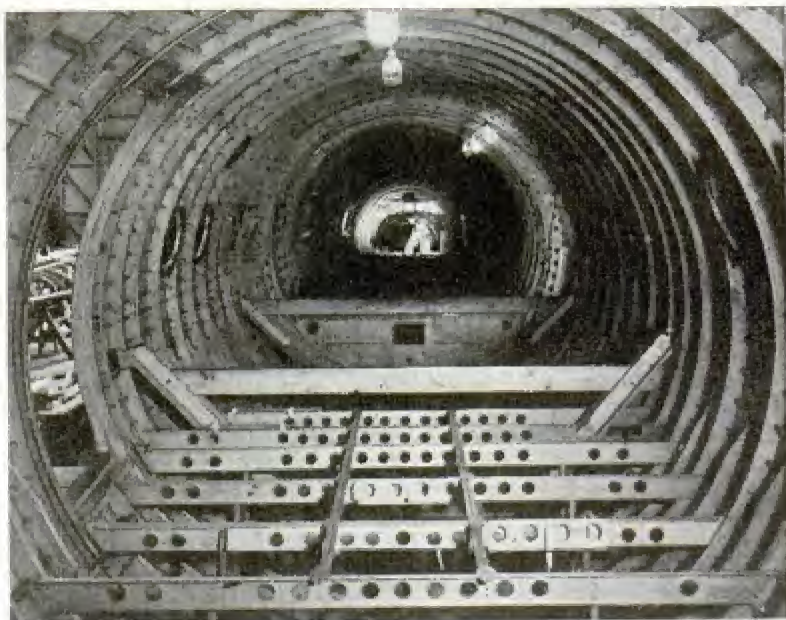
flight range puts transpolar operations between the New and the Old World on a feasible basis, or, flying a Great Circle course, it could bring Chicago closer to some parts of Europe than is New York.

The big transport's startling performance results from its aerodynamic shape, which in turn is based on a number of things. The plane has no more drag than has the Lockheed 14, a plane of about one-tenth the size and horsepower. Its final shape was determined after six months of wind tunnel studies. For smoothness, the skin is all flush riveted or spot welded.

The Constellation's wing is an enlargement of the P-38 "Lightning" wing, and contains two sets of flaps. With all its flaps telescoped, the plane is streamlined for speed and distance. With its maneuvering flaps in operation it is fitted for rapid climbs out of short fields or for slow speed maneuvering. With its landing flaps extended it settles



Left, starboard rudder and tail group. Below, building cylindrical fuselage of the cabin, pressurized for high altitudes

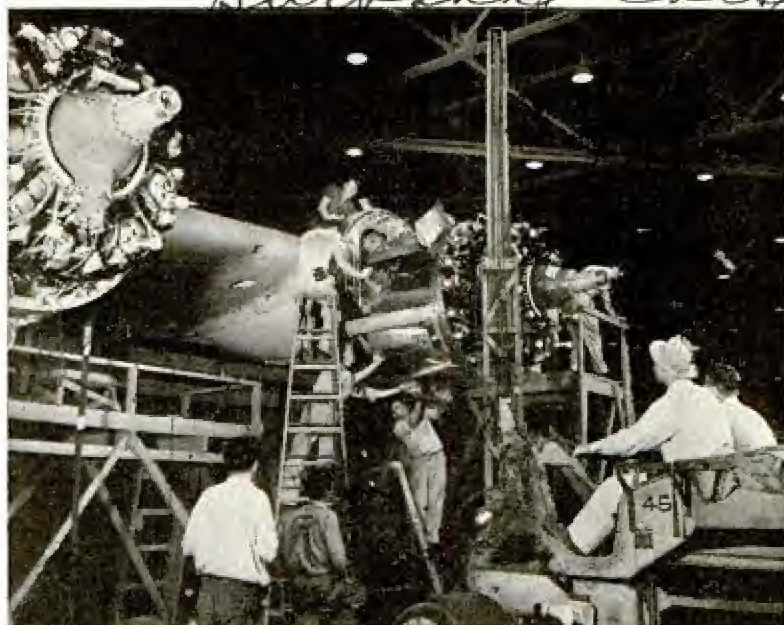


Rep. William L. Wright, Public Relations, Lockheed Aircraft Corp Burbank Calif

into an airport at reasonable automobile speeds.

The plane is designed for optimum operation at 20,000 feet and has an air conditioned pressurized cabin in which an air density of 8,000 feet is maintained. It can climb to 35,000 feet in case of need. Ordinary icing hazards are avoided by its "hot wing," engine exhaust gases being used to keep the temperature of the leading edge above the icing point. Functioning of its complex hydraulic control system has been insured by tests for temperatures down to 70 degrees below freezing. The pilot operates the big control surfaces with ease by means of hydraulic boosters.

The plane's triple tail is designed to insure positive control under any conceivable engine emergency such as the failure of one or more power plants during take-off. The tail rises less than 19 feet off the ground, as compared to the 27-foot height of the DC-4, an advantage when the plane is to be placed in a hangar.

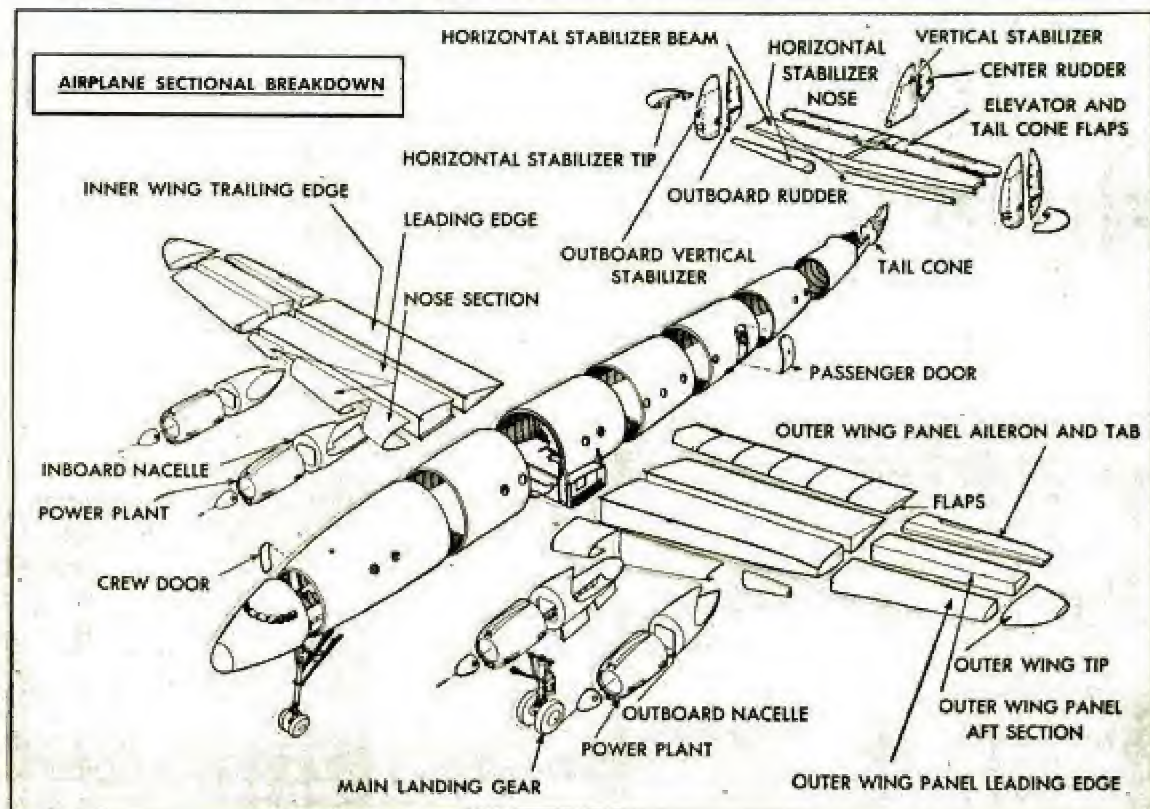


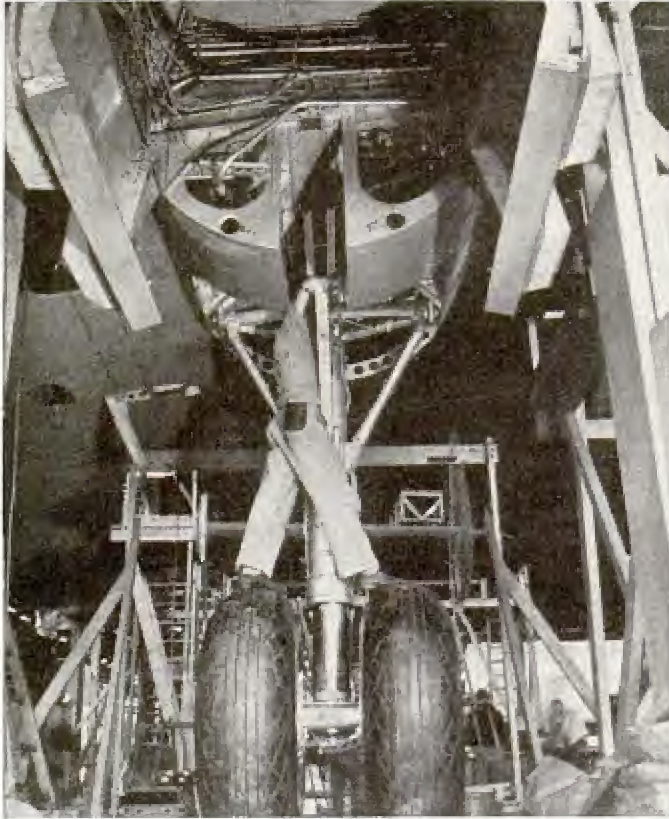
Installing an engine as a complete unit, minus props and nose cowlings

The plane can cruise at 25,000 feet on three engines or can maintain altitude at 16,500 feet on two engines.

It has an electrical fire detector system leading to 16 thermostat stations in each engine nacelle, together with switches by which carbon dioxide fire extinguishers may be turned on in various parts of each engine compartment.

Sectional breakdown drawings like this enable workmen to visualize their work better than blueprints





Above, completing installation of one of the double landing wheels. The tricycle gear of the big ship is retractable. Below, one of the largest airplanes ever built, the Constellation has a low profile which permits it to enter hangars comfortably



As a final safety measure, nacelles and cowlings are of stainless steel so that an engine fire could burn for half an hour without seriously hindering operations of the big ship.

The big Wright engines may be serviced in flight and each may be unhooked from the wing and a new one installed in 45 minutes. There are four separate fuel systems and four independent lubricating systems.

The contours of the engine nacelles have been designed to avoid air compressibility shocks at high speeds.

When designed, the Constellation was intended as a luxury liner for use by T.W.A. This is the service it will enter after the war, but at present the first and succeeding Constellations will be used as military transports. As such one of them could fly a light tank and its complement of troops and supplies across an ocean. The flight station, in the forward upper part of the fuselage, contains seats for the pilot, co-pilot, flight engineer, and radio operator. Behind a bulkhead are the navigator's station and quarters for the crew. Aft of this is cargo space, then the main passenger compartment. Additional cargo space is available under the cabin floor. The accommodations include an interphone system that connects with the pilot, co-pilot, engineer, radio operator, navigator, cabin entrance door, at every engine nacelle, and at the external battery receptacle.

To insure rapid production and to permit interchangeability in service, all such parts as wing tips, ailerons, wing flaps, tail surfaces, inner and outer wing panels, landing gear, and engine cowlings are jig-built. Differences in left- and right-hand parts are kept to a minimum.

The following parts are identical and may be used either on the right or on the left side of the plane: engine mounts, exhaust collector rings, engine cowls and nacelle cowlings, elevators, landing wheels, brakes and retracting mechanisms.

Lockheed engineers are tooling up now to go into production on the Constellation on a large scale.

Smoke Generator Lays Screen to Hide Troops

Smoke said to be markedly similar to natural clouds and fog, and so dense and persistent that areas may be covered economically for long periods, is produced by a mechanical smoke generator developed by Dr. Irving Langmuir and Vincent Schaefer of the General Electric Research Laboratory through the National Defense Research Council for the Chemical Warfare Service of the Army. The generator is said to utilize liquid material more efficiently than in the past.

Seemingly endless clouds of smoke, markedly similar to clouds or fog, pour out of jets of generator designed to hide movements of troops

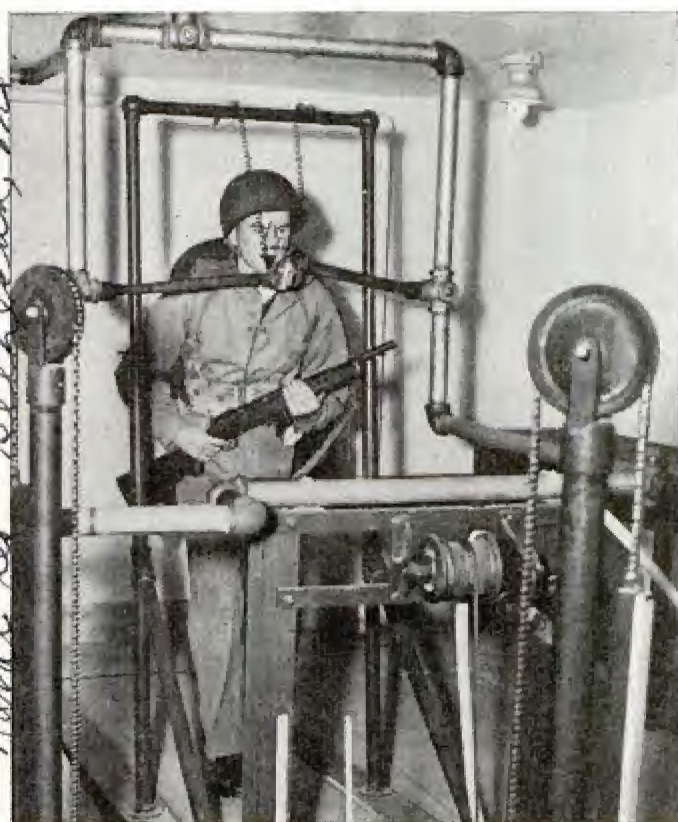


Dr. Irving Langmuir

Navy Weather Room Treadmill Tests Men for Any Clime

How Americans react to the fever heat of tropical jungle and desert and the raw

cold of the far north, and how they can be fortified against those climates, are subjects of research at the Naval Research Laboratory, which has devised a weather room that can simulate temperature and humidity of any climate on earth. Men with full packs are tested on a treadmill in the weather room, to determine the effects of these artificial climates on such vital functions as heartbeat and respiration.



Respiration of marine on treadmill is tested during workout

JUNE, 1943

Fewer Rail Passengers Set Travel Record

Though not as many individual passengers rode railroads last year as in 1920, the record year for that figure, the number of railroad passenger-miles traveled in 1942 was the highest ever. That was because the average length of each passenger's trip was 79 miles, while in 1920 the patron's ride averaged only 38 miles. In 1942, 601,972,000 patrons rode a total of 47,357,474,000 passenger-miles; in 1920, 1,133,535,000 passengers were carried a total of only 43,198,479,000 miles. The average passenger train in 1942 carried 122 patrons, in 1920 only 85 persons.

Railway age.
Mar 13 - 43

13th Street

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105-Foot Refinery Tower Spans Three Flatcars



Three flatcars were required to accommodate this huge fractionating tower, which weighed 476,810 pounds

Bedded down for a trip by rail of over 1,000 miles, a huge fractionating tower, used in refining finished petroleum products from crude oil, required three flat cars

to accommodate its 105-foot length. The tower was manufactured in one piece by the Wyatt Metal and Boiler Works, and its completed weight was 476,810 pounds.

Houston, Texas

Building's Facade Is Shaped Like Flag of Brazilian State



Windows form stripes and seal of Brazilian state flag, and even flagpole

Curving like a banner whipped by the breeze, the windows of the Casas Pernambucanas in Sao Paulo, Brazil, represent the stripes of the flag of the state of Sao Paulo. A circular pane at the top represents the state's seal, and narrow horizontal windows at one side, which let light and air into a stair and elevator hall, are almost circular, and represent the flagpole. The flaglike effect is heightened by shadows from the overhang of the windows.

"Outdoors Icebox" Winter-Tests U.S. Arms

Nine hundred officers and men of the Army Ordnance Department spent a wartime winter at an ordnance proving ground in Manitoba, Canada, where temperatures often fall to 50 degrees below zero, to test, prove and develop every weapon used by America's fighting men under

POPULAR MECHANICS

Clipping

The Casas Pernambucanas, in Sao Paulo, Brazil

Robert Gregg

weather conditions as severe as are likely to be encountered anywhere in the world. Refinements against cold-weather failure have been checked against tests in factory cold rooms, and on occasion the actual field conditions brought out needs for changes not apparent in laboratory cold tests. Bombs, from the smallest to huge block-busters, were tested in the bitter cold, as were projectile fuses, guns, tanks and other mobile equipment. Stop watches timed the period needed to set up a battery, or get a convoy in motion. In one instance, artillery that a year earlier failed to function at prolonged zero exposure was made to operate faultlessly at 40 below.

Glass Blanket Insulates Hut For Air Corps in Arctic

Portable igloo-type shelters insulated with blankets of glass fiber are designed to keep U. S. airmen in the Arctic comfortable when the temperature falls to 40 or more degrees below zero. The arched roof and side walls consist of quilt-like sections supported by laminated wood ribs. The sections are composed of glass fiber insulation enclosed with cotton fabric treated with a plastic material that makes it waterproof and fire resistant. Floor is of plywood with a layer of fireproof insulation on the under side.

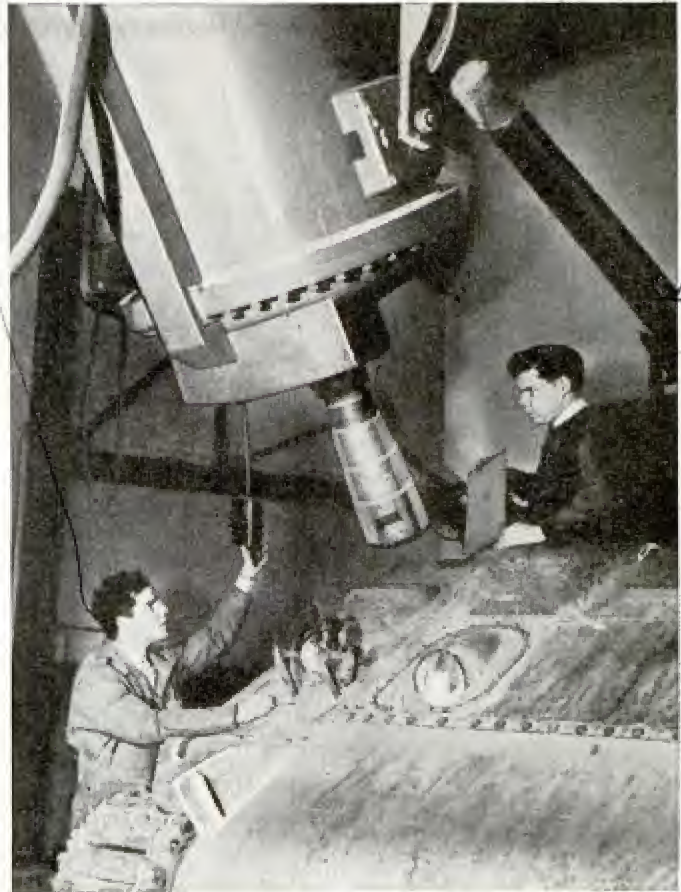


Fireproof walls of shelter roll up like blanket, pack easily in plane

JUNE, 1943

James mfg co
Fort atkinson, Wis.

Welded Seams of Tank X-Rayed To Guard Against Flaws



Henry
Lubin

X-ray's eye determines if tank welds will stand up in battle

Not even the massive steel plates that form an M-4 Army tank can withhold secrets from the probing eye of a million-volt X-ray machine used in the Ford River Rouge plant to check welded seams.

X-ray photographs are made along the line of the weld to make sure it contains no hidden flaw that might show up as a weakness in time of battle. Metallurgists testing the welds work in teams, one of the men operating the controls of the giant X-ray machine while another holds a sensitized plate beneath the section of the tank which is to be photographed.

¶Ninety-two percent of all United States mail is carried by the railroads, the total in a year reaching 5,800,000,000 pounds, 17,000,000 separate pieces of mail.

Cont: C. N. Moore; 1362 N. Dearborn
Chicago, Ill

WELDING for WAR and PEACE



EVERY new achievement in America's phenomenal record of war production brings added evidence that the greatest single manufacturing factor in making the United States the arsenal of democracy is welding.

No matter whether you read about ships launched in days instead of months, great plants rising where tall corn stood, or monster tanks completed on a virtual "while-you-wait" basis, you'll find that welding made these feats possible.

This was true when Hull 440 became Liberty ship "Robert E. Peary" in just 4 days, 15 hours and 29 minutes at the Richmond shipyard of Henry J. Kaiser.

It was true when an automotive producer tore up an original schedule calling for building a tank plant and making Tank No. 1 in nine months and did the whole job in 47 days. It has been true in countless other cases.

Such accomplishments are sometimes credited to prefabrication—correct, as far as it goes. But prefabrication is simply manufacturing in sections and then assembling the sections into a complete unit, and it's a matter of

Spectacularly masked welders are literally stitching together with fire the vessels that become America's bridge of ships to the fighting fronts. Above, welding the bottom hull plating of a 300-foot freighter. Below, repairing a vessel's stern frame



Ref: The Lincoln Electric Co
12818 Coit Rd, Cleveland, Ohio

industrial history that there was no large scale prefabrication until welding had reached its present high state of efficiency, making possible the welding of all common base metals, most of the precious and semi-precious metals, and many dissimilar metals, one to another.

Welding has been called the backbone of war manufacturing. Certainly, 750 merchant ships would not have been launched last year had not 600 of them been of the Liberty type, an all-welded construction.

A step-by-step story of welding in wartime may never be told, so rapid has been its applications. Based on the accepted yardstick

Right, welding a prefabricated ship part that will travel six miles to point of assembly. Below, brazing motor connections



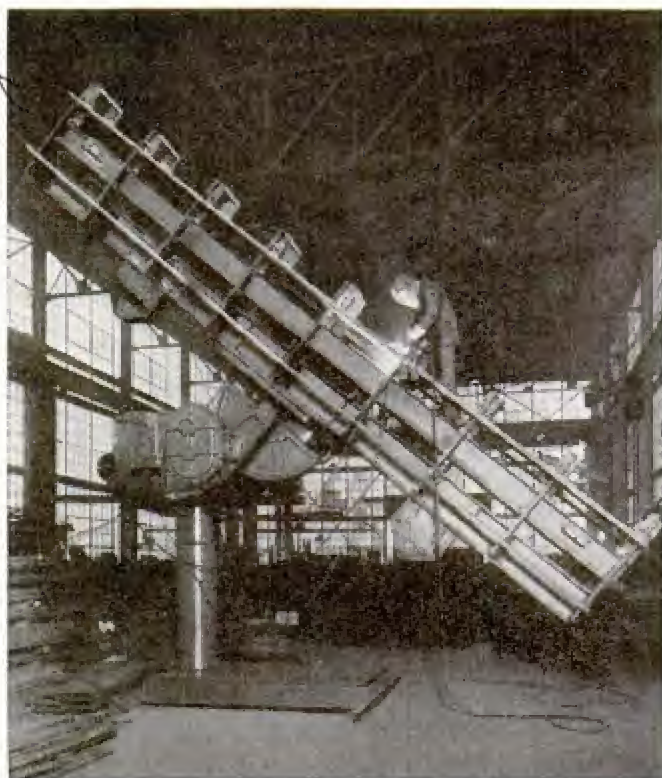
of tonnage production of welding electrodes, the volume of welding has increased over 1,900 percent in the last few years.

Not only has welding cut down production time, but it has resulted in two other major savings. The first is a saving in critical material. This is possible because rivets, and the overlapping metal necessary in riveted construction, besides many whole castings and parts, are eliminated by welding.

Acetylene flame melts metal like butter under a hot knife. Melting and refusing is principle of welding



myd by Cullen. Triestel & Co
Chicago



"Positioner" permits welder to approach all sides of a bulky welding job, since it revolves, tilts and adjusts to height

The second is a saving in dollar cost, because welding is faster, requires less material and because its application has been so simplified that no complicated or lengthy training is necessary for most workers.

The extent of these savings may be illustrated by several studies completed by the James F. Lincoln Arc Welding Foundation following the conclusion of its recent program for stimulating the scientific progress of welding in which 408 awards totaling \$200,000 were made to designers and engineers for new welding ideas and applications.

Based on representative entries in the award program, the following figures show the annual savings possible by welding: Total savings in cost, \$1,825,000,000; total savings in steel, 7,000,000 tons; total savings in cost of steel, \$271,000,000 based on prices of \$34 a ton for billets and slabs, and \$42 for plate; total savings in labor, 153,000,-000 man-hours.

Arc welding is used to assemble gun turret houses for U. S. Navy

Many of these savings already are being accomplished, since numerous ideas which received awards in the Lincoln program already have been adopted by war industries.

Estimated savings in costs, covering both time and material, made possible by arc welding alone range from 26 to 50 percent in automotive products, 14 to 90 percent in railroad equipment, 37 to 67 percent in water transportation equipment, 26 to 45 percent in structural equipment, 7 to 44 percent in furniture and fixtures, 10 to 53 percent in containers, 15 to 83 percent in functional machinery, and 25 to 69 percent in industrial machinery.

The logical conclusion is that welding will have a pronounced influence on postwar manufacturing. Many industries which, under stress of war, are using welding for the first time, or are using it more extensively, will continue its expanded use in the highly competitive market that is sure to develop when the war is over, and when such sales requisites as appearance, price, utility and efficiency will be of primary importance.

James F. Lincoln, in whose honor the Lincoln Arc Welding Foundation was established, and head of the Lincoln Electric Company of Cleveland, makes these predictions, "based on welding's record so far:"

"1. The rivet will disappear as a means of joining steel.

"2. The forging and the malleable casting will be used only sparingly.



*Earl Kinchen at
Valusia County Fla.
Vocational School*

"3. Steel and iron castings to the extent of 75 percent of what now are being made will be replaced by welded steel."

Mr. Lincoln continues:

"The commercial application of welding began during the last war and its progress since that time has been phenomenal. It remained, however, for this war to force its application throughout practically all metal-working industries, overcoming entrenched conservatism in many cases.

"The now assured important place occupied by welding offers an outstanding opportunity for the welding engineer after the war because it requires imagination to redesign parts so that they can be most economically welded. To copy appearance of the previous structure obviously is wrong. New appearance, new design, new technique and new imagination will make the new products not only tremendously cheaper and more reliable but also more attractive."

New ways in which welding is being used to speed wartime production may presage what is to come with peace.

Airplane propellers now are being welded for the first time. It has been found that money can be saved and construction simplified by welding manhole covers for barges and boats, thus making them flush with the decks. Wooden plates are being fastened to steel decks by using welded studs. Thermit welded frame construction for joining cast stern-frame sections into complete sections in building ships increases speed, gives a more durable unit and makes unnecessary large, intricate castings with their attendant manufacturing, shipping and handling difficulties.

Welding has also proved its wartime value in repairing broken equipment of all kinds, from agricultural implements to factory machinery. It has been found that by welding much equipment formerly scrapped can be reclaimed without requiring new parts.

(Continued to page 166)

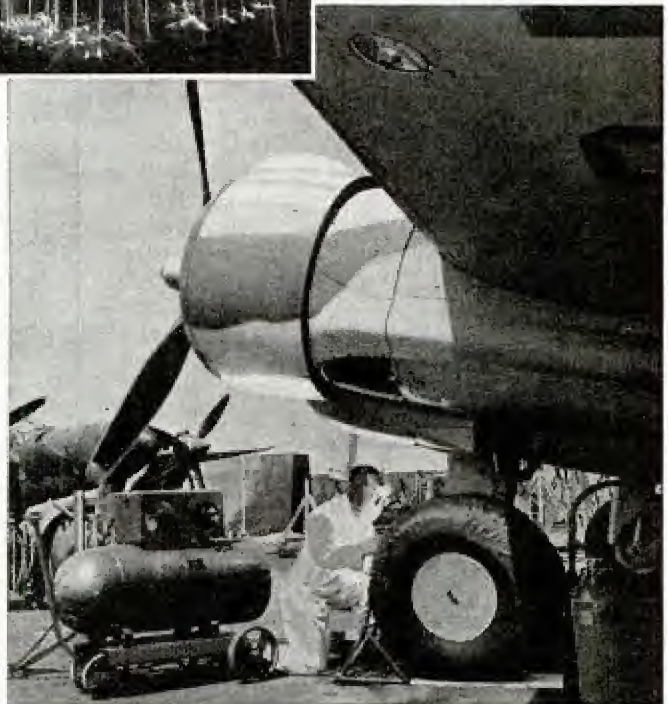


Overhead welding is tedious and exacting, but housewife (above) soon will be using her new skill on a plane plant production line

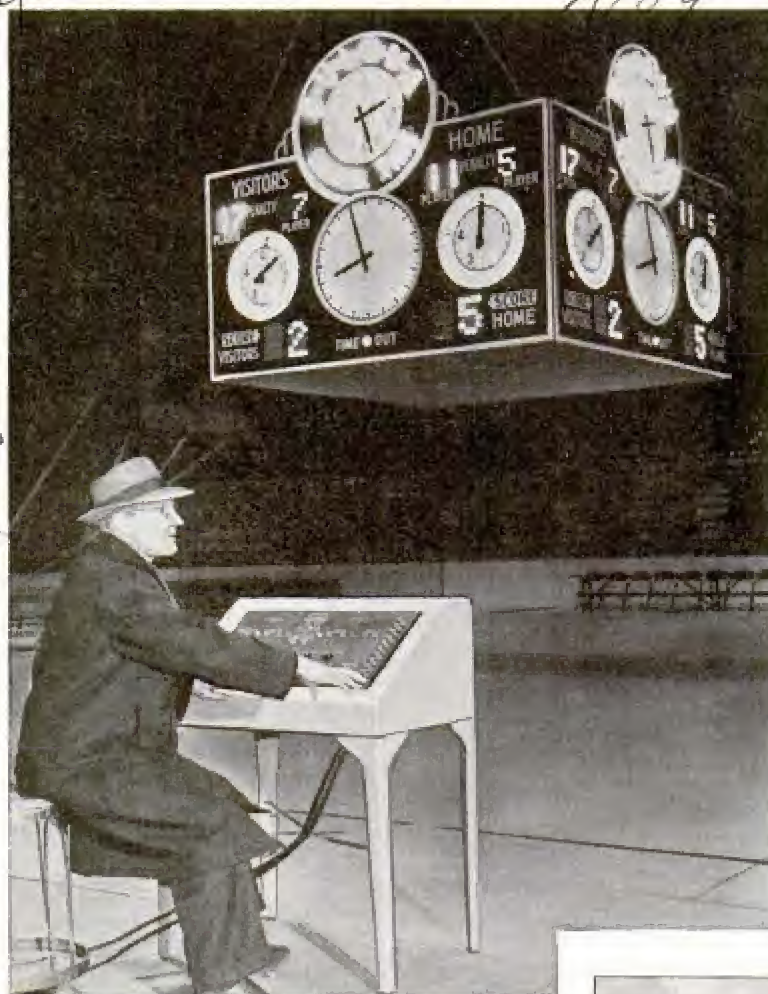


Intensely hot electric arc fusing metal of a massive pedestal sends down showers of sparks in a fountain-like display (left)

Portable equipment permits welder to work on production line or battle line, lending a hand to keep America's planes flying



Two-Ton Clock Flashes the Score And Times Play of Games



Lights, bells and sirens are controlled from board

Weighing two tons, a combination electric clock and scoreboard keeps an automatic tab of hockey and other games in the Chicago Stadium. The clock times play and time-outs, records penalties, and tells the score in flashing multicolored lights from each of its four faces which measure 10 by 12 feet. It is suspended high over the center of the stadium floor and is operated by one man at the control board. Sound effects include bells, whistles and sirens. While designed for hockey and basketball, the timer can also be used for boxing.

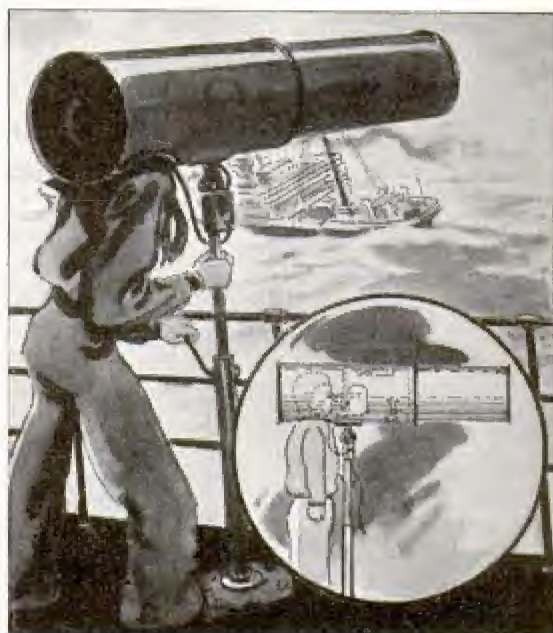
Window Screens Made of Nylon Seen for Post-War Homes

Nylon window screens, that can be produced in any color, will not corrode, will not permanently bulge if struck, and can even be rolled up like window shades in

winter, are foreseen by du Pont chemists for housing after the war. Pencils or other sharp-pointed objects may be pushed through such screens without damage, and preliminary tests show they stand up well even along the seashore, where salt spray rusts or corrodes metal rapidly. Nylon wire cloth, with which the company has been experimenting for some time, can be bent back and forth millions of times without breaking.

Visor Shields Head Of Ship Lookout From Weather

Seamen on lookout duty may be shielded from foul weather by a barrel-like visor, just patented by Gilbert S. Macvaugh, United States Navy. The head fits into an opening at one side of the tube, and the opening itself fits snugly to the lookout's body, providing a weathertight closure and leaving both hands free. Telescope and phone equipment are built in.



Visor's barrel covers lookout's telescope and phone

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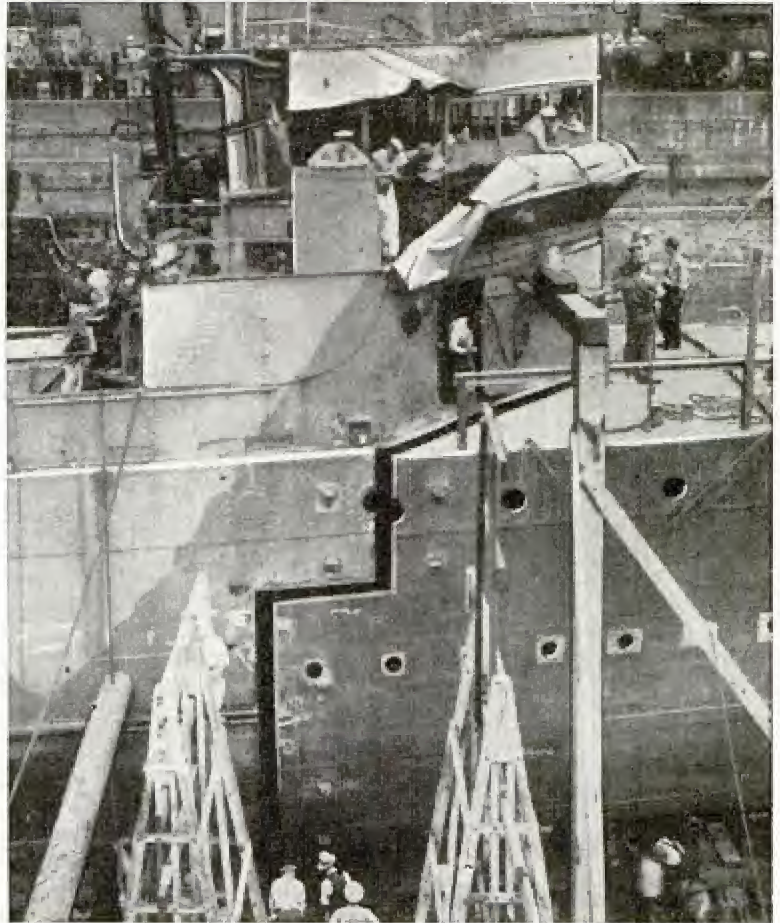
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Jigsaw Method Fits New Prow to Destroyer

As a limb is grafted on-to a tree, a new prow was fitted onto the U. S. Destroyer Blakeley at the Philadelphia Navy Yard, to replace the bow blown off by an enemy submarine in the Caribbean. After that attack the Blakeley was first fitted with a wooden bulkhead to keep out the sea, then, at a West Indies repair station, a steel false bow was installed to serve until she could be given final repairs on the mainland. At the navy yard the bow of the decommissioned destroyer Taylor, a sister ship, was cut away to fit the damaged vessel, and warped into place as neatly as two parts of a jigsaw puzzle.

Damaged by an enemy torpedo, the U. S. destroyer Blakeley made port with a makeshift bow, and was fitted with a new "nose" formed by cutting away a bow section from another vessel of the same class

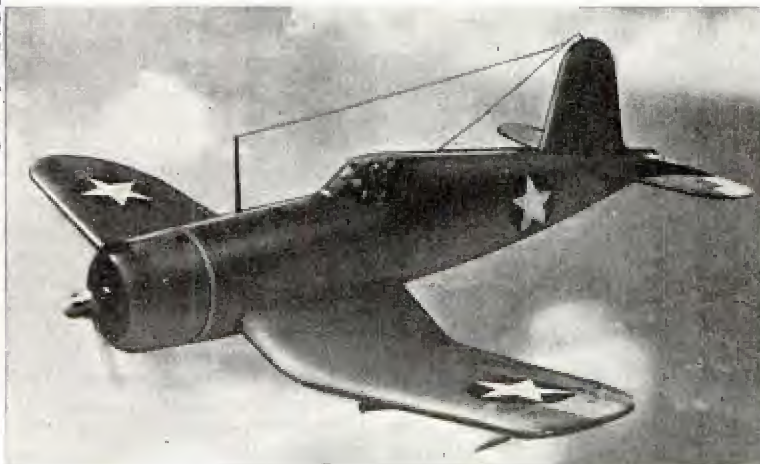


New 400-M.P.H. Carrier Plane Has Pint-Size Fuselage

Hailed by the Navy as its fastest fighter, the new Vought-Sikorsky carrier plane, the Corsair, is literally an engine with wings and tail assembly. Its 2,000-horsepower air-cooled engine and the smallest possible fuselage for that size engine, help to give it a speed of more than 400 miles

per hour. With the largest propeller that can be used on a ship of this design, it climbs "upstairs" in a hurry. The service ceiling of this single seater is 35,000 feet. To eliminate drag, its landing gear, tail wheel and arresting gear are not only retractable but fold within the streamlined

body. Even the rivets are flush. The folding-type wings of gull design have a span of 41 feet and the plane is 33 feet long and 16 feet high. Although the Corsair is large for a fighter, it is said to be highly maneuverable. Besides its home plant in Connecticut, the Corsair is being built in a Good-year plant at Akron, O.



Wings of gull design are distinguishing feature of the Navy's powerful new fighter, Corsair, with speed over 400 m.p.h.

By Sgt. George E. Lord

^{7/13}
A DARK speck tumbled from the plane circling high overhead and plummeted earthward at a spine-chilling pace. A scattered crowd of men watched tensely for a burst of white silk to break the fall. Suddenly it came. The dangling figure snapped in a wide arc, drifted and landed in the corner of the field in a heap, shaken but unhurt.

To most of the onlookers it was just another parachute jump. But to the jumper, Lt. Col. C. E. Shepard, Jr., it marked the completion of a record that is a credit to the Marine Corps. The Colonel's was the 10,000th jump without a fa-

FALLING DYNAMITE

It's 250 feet to the floor as a Paramarine gets his first chance to put into practice his knowledge of maneuvering a 'chute in a jump from training tower



U. S. Marine Corps photos

Basic calisthenics and mock plane drill out of the way, the paratrooper drops in harness from top of tower and is caught by his straps with the effect of an actual free jump

At left, a member of the U. S. Marine Corps parachute troops executes a tumble to avoid injury as he hits the dirt after leaping from a plane

tality at the Marine Corps Parachute School at Camp Gillespie near San Diego, California, and a new series of safe jumps was started immediately as Major T. M. Trotti, executive officer, followed his commanding officer from the plane.

Thus, with the efficiency which marks every phase of their rigorous combat training, the Marine Corps has turned the stunt of the daredevil of yesterday into today's marvel of coordinated striking power—the Paramarine.

Tough, rugged and highly trained, the Marine Parachute Trooper is the product of five weeks of one of the toughest training schedules known in the Corps. Every Paramarine is a volunteer, and requirements are stringent. He must be unmarried, between the

Lt. Col. C. E. Shepard, Jr., at lower left, makes the 10,000th jump at Paramarine school without a fatality



"Stand by to bail out!" is the order as Colonel Shepard steps out for the record leap

ages of 18 and 32, have completed recruit training, be athletic, well-proportioned, weigh from 135 to 190 pounds and be between 66 and 73 inches in height.

In addition, he must pass a physical examination, and a modified flight examination in visual acuity, binocular vision, depth perception, flight ear examination and equilibrium facilities.

In his 12-inch jumping boots, flying helmet with chin strap and his coverall jumping suit, the Paramarine recruit spends the first few weeks at the school getting into the perfect physical condition required to absorb a rough landing. To develop his leg muscles, he does everything

(Continued to page 165)

Marvin Myers

(241 College St., Wadsworth, Ohio

Wire Spirals in Plane Tire Prevent Skidding



Thousands of steel-wire spirals comprise the tread of airplane tires designed to prevent skidding on snow and ice, in production by Goodyear Tire & Rubber Co. The wire coils are strung on steel rods to be transferred in parallel rows to rubber mats. Mats are then linked together with cement into a strip long enough to cover the surface of the tire carcass, and the carcass is next placed in a mold in the normal fashion. As the tire carcass is vulcanized, the thousands of wire coils become integral parts of the tread, scarcely noticeable when the tire leaves the mold.

Wire spirals are vulcanized directly into the tread of plane tire to prevent skidding

Floating Litter Holds Ship Victim's Face Above Water

With a special litter for victims of the war at sea, injured or even unconscious men may be lowered into the water, to await rescue. The litter, in two disjointed sections, is strapped to the victim's back to provide support for his body in the water. Removed, he may be carried in it. A face guard holds his head above water, while a life belt provides buoyancy. First aid kits may also be strapped to his body. With such an arrangement, wounded sailors or men in sick bay may be safely removed from a stricken vessel if the order comes to abandon ship.

Life belt for buoyancy, face mask to hold his head above water, and litter strapped to his back make it possible for injured man to float until rescued



Six-Gun Messerschmitt Fighter-Bomber Has 365-M.P.H. Top Speed

Germany has modified one of its standby fighter plane models, the Messerschmitt, into a twin-engine craft, called the Me210, credited with a top speed of 365 miles an hour. The new model is a two-place job, and is capable of acting either as a fighter or as a light bomber, presumably for hit-and-run raids. Its armament includes six guns, two of them being cannon in the nose and two machine guns.



Luftwaffe's standard fighter is modified into fleet hit-and-run bomber

Schenectady, N.Y.

J. C. Smith
J. E.
77 71

"Paper Dolls" Guide Cutter, Save Vital Metal

Metal parts for war machines come in an endless variety of shapes and sizes, most of them stamped out of light metal or flame-cut out of plate over one-quarter inch thick. Some of the parts for tiny motors or huge turbines built at General Electric Company are in the shape of simple circles, some triangles; some resemble stars, banjos, or top hats. The problem, with metals scarce, is to cut as many as possible from a single sheet of metal. To achieve the maximum number, planning men resort to "cutting paper dolls." Parts are drawn to scale on ordinary paper, then cut out with a pair of scissors and reassembled, jigsaw fashion, until the greatest possible number are nested on a form the size of the metal sheet or plate from which the actual machine parts will be cut. The jigsaw layout is then sent to the factory for guidance in actual cutting. This pre-planning assures

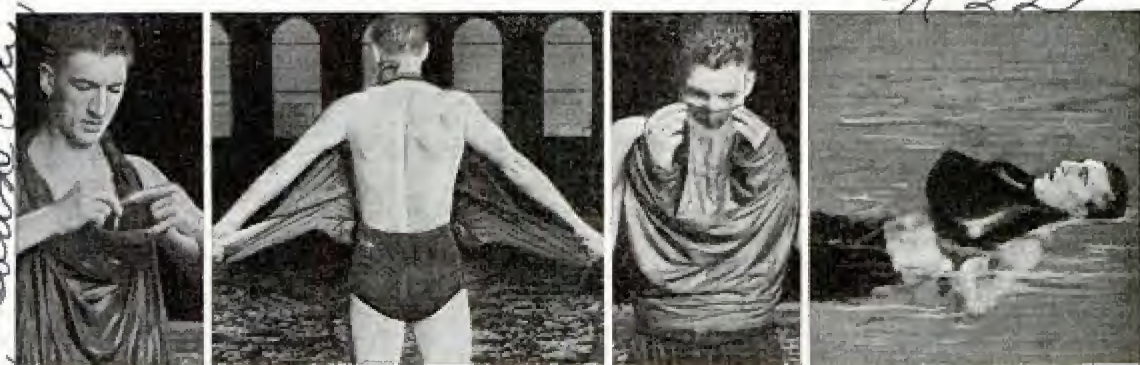


Pattern layout permits cutting of most parts from least metal

a minimum of waste and a maximum number of parts, saving precious material and at the same time speeding production.

U.S. Navy Preflight School, Sand Creek, Colo.

Flier's Shirt Can Be Inflated to Form a Life Preserver



To make shirt buoyant, tie sleeves and tail behind back, button collar, and blow into "bladder" thus formed

With the waterproofed shirt from his uniform, a Navy air cadet is taught to fashion a life preserver that will keep him afloat for several days. The sleeves are knotted and thrown over the head, and the collar

is buttoned. The tails are tied behind the cadet's back, and the shirt is inflated by blowing into it so that it becomes a bladder which is buoyant enough to keep a swimmer's head above water.

William Gordon
Detroit, Mich.

Self-Running Postwar Refrigerator to Have Electrically Operated Door

Push-button control to close, as well as open, the doors of post-war model refrigerators was forecast to the American Society of Refrigerating Engineers by Glenn Muffy of Springfield, Ohio, who also foresaw that the machines will provide automatic defrosting, zero chambers for frozen foods, automatically released ice cubes, and ice water from a faucet. It might even provide a warm, dry storage space by uti-

lizing waste heat from the condenser unit. Instantly available ice cubes might be obtained by freezing them on separately refrigerated spots on or near the bottom of a water tank which rests on raised areas of the evaporator units. During idle periods of the evaporator, these disks would melt free and float upward to the top of the water, from where they could be scooped out when desired.

Science Service
Mar 8 - 43

Cont: Allen Warren Elliott, 7 York Dr
N.Y.C.

SEA-GOING SHUTTERBUGS



Above, Navy photographers "shoot the angles" in the Brooklyn Navy Yard. Below, a bluejacket climbs the stack of a warship to find a vantage point for a camera shot



m 1066

SOME of the most effective shooting now going on in this breathtaking war of action isn't being done with guns at all.

It's being done with cameras gripped in the quick young hands of navy cameramen. Cameras big and small, simple and complex, operated with icy accuracy by bluejacketed, seagoing shutterbugs who can take a piece of flying shrapnel or a bomb fragment along with a picture. Cameras focused by lads who can lay aside the black box and pick up machine gun controls when things get too hot—to plaster with bullets the Japs or Nazis they have just photographed.

The camera has at last become an important implement of warfare at sea. And it has become an unexpectedly effective morale builder, too.

"Jap Cruiser Blasted in Pacific Battle!" the headlines scream. Some who scoff at all war claims scoff at this one. But not after the Navy Department releases the photographs to be flashed across the nation by wire transmission. Each picture is worth a thousand words of description. Photos showing a heavy Japanese cruiser wallowing in flames, gun turrets twisted, plates buckled, catapults blown to bits, decks

shattered and stacks askew. Chalk up a victory for our boys in blue! Even scoffers straighten their shoulders in pride at this example of American prowess.

The angle from which the photo was taken indicates it was shot from the air. This means some anonymous navy shutterbug probably took off from the deck of a distant carrier in the midst of a still-raging battle. Possibly he braved the guns of



↑
At a naval school of photography a student is shown how to aim aerial camera

This famous shot of the Japanese heavy cruiser of the Mogami class was caught by flying cameraman in Midway battle
U. S. Navy photos



Photographers of Third Naval District, New York City, film → a plane from auxiliary vessel

zooming Jap Zeros. Certainly he took a chance of a solitary death on a lonely expanse of tropical sea. Yet he brought back a picture as perfect as he might have made back home at a cozy church wedding.

It turned out to be a morale stunt, but it was intended primarily as a routine record shot to be studied by naval experts for what they could learn as to the effect of gun-





Students at Pensacola naval air station learn to "shoot" from a plane



tographer who made this picture was a member of the American submarine crew.

Are we knocking off Japanese planes? The photographer brings back pictures showing three enemy aircraft simultaneously plunging into the sea at the end of streamers of smoke and fire. This photographer might have been the pilot of the observing plane as well as the shutterbug, for many of them are double-duty men.

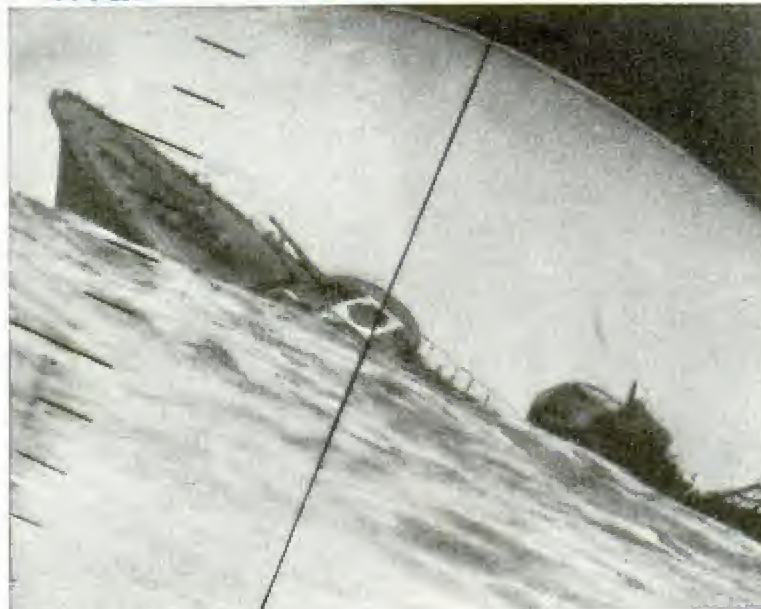
What were we fighting for in a Pacific Island battle area? An airfield? Well, the navy photographer gets the picture of the field, showing American planes on the ground—the best evidence that we captured it. Once more the photo is intended as a record shot, helpful to military strategists far from the battle scene. But it proves to have morale value, too.

fire, aerial torpedoes and bombs on Japanese armament. For the cameraman it was just another assignment to be covered by one of the navy's new fighting photographers.

Are our submarines sinking Japanese warships? They are, and the navy photographer produces proof in the form of the first action photograph ever known to have been taken through the periscope of a submarine, showing a Nipponese destroyer slipping to her grave beneath the ocean surface, enemy seamen scrambling in panic along tilted decks, silent guns pointing skyward like the fingers of doom. The photo-

Are we bombing Japanese military installations in the Solomons? The navy photographers deliver the goods again and even civilian armchair strategists can study the photographs in newspapers and magazines and pick out the bomb craters in an airfield, see the shattered docks, the blackened oil tanks, the blasted radio huts.

Seagoing shutterbugs are bringing the naval war home to the people, recording our losses as well as our victories as in the case of the Pearl Har-



Sub's eye view of sinking Japanese destroyer was first war scene shot through a periscope

bor photos and the series showing the sinking of the gallant aircraft carrier Lexington, some of the most dramatic and artistic and tragic photographs ever made.

Navy photographers have caught torpedoed cargo ships as they sank in the Atlantic, snapped closeups of tanker crews fighting fires on their shelled ships, have shown patrol boats exploding depth bombs on submarines, have pictured the rescue from the sea of crews whose ships were blasted from underneath them.

Before a naval air attack on Wake Island, a Navy PBY patrol bomber carried negatives showing the Japanese installations on the island to an aircraft carrier and dropped them on the flight deck. The negatives were rushed to the photographic laboratory which has been installed on every carrier in the navy, prints were made and from these prints the plan of attack was made.

When President Roosevelt made his secret trip to the nation's armament plants, two navy photographers were the only cameramen permitted to make photographs. Their task, a difficult one because of protocol complications in dealing with their superior officers, was well done.

These seagoing shutterbugs have given their lives and their blood already in this war and are already building epic stories of their bravery. When Commander John Ford, who directed the Academy prize-winning picture "How Green Was My Valley" before joining the navy, took a machine gun bullet in an arm while film-



These navy shutterbugs are used to perilous perches

The cameraman was busy in the Yorktown's last hour





Fortunately, the decision to expand photographic operations was made a few months before we entered the war. When Lieutenant Commander E. John Long, a reserve officer, was called into service to take charge of this branch in Washington, all of the releasable photographs the navy pos-

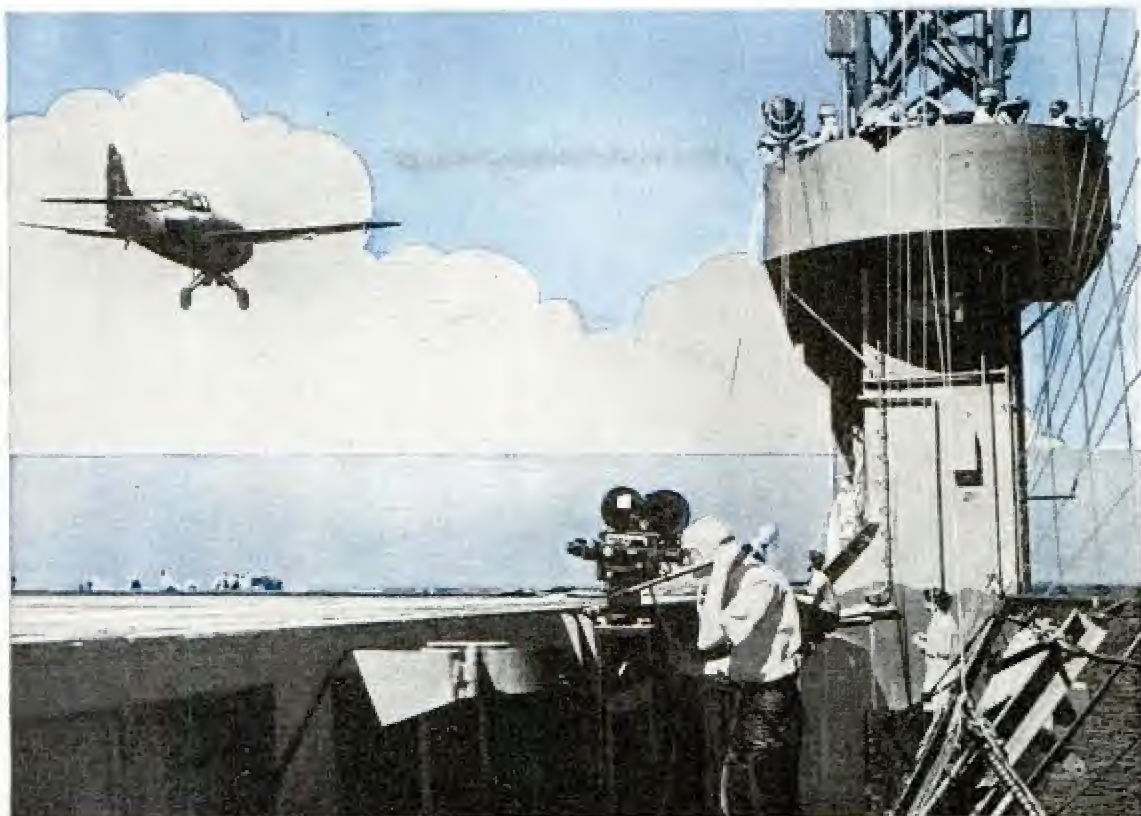
The "Big Bertha" at left is used for high-altitude or long distance photos. Below, studying photographic mapping with aerial camera at Pensacola

ing a Japanese attack on Midway from the exposed tower of a powerhouse, he went on turning the movie camera until his job was finished.

The navy, which has never been overzealous in seeking publicity, started its camera program as a method of modernizing its internal operations. The morale angle, which has shown the nation the difficulties it has faced and the feats it has accomplished, especially in the Pacific, just grew "like Topsy," as the fact-hungry nation applauded its pictures.

A destroyer noses into smoke to pick up crew as cameraman records the tragic death of the aircraft carrier Lexington





Every carrier has its own crew of cameramen. Here a movie man on the "island" films the takeoff of a plane

essed were contained in five filing cases.

During the last three prewar months, a program was rushed through under the direction of Captain C. T. Durgin and a group of officers in the Photographic Section of the Bureau of Aeronautics.

With exceptional vision, these trained photographic officers began to place cameras and cameramen on combat ships of all types. Previously there had been photographic units only on the battleships, aircraft carriers, and principal tenders, but it was early realized that a seven seas war could not be depicted photographically by units that, as a rule, traveled together, leaving a great many places and ships without either photographers or photographic equipment.

Laboratories were set up in Naval Air Stations in the West Indies, Alaska, Hawaii, Philippine Islands, Iceland, Newfoundland, Bermuda, Ca-

nal Zone, as well as the scores of Naval Air Stations and Naval Training Stations throughout the continental United States. Mobile units were added.

Photographic volume was stepped up until the Office of Public Relations alone handles about 1,000 photographs a day and this only a fraction of the navy's photographic traffic. Most photography in the



At a California naval air station a sailor grinds away from a platform mounted on a truck



This big mapping camera is shooting earthward from a "Catalina"

Navy is still for its technical services, and only a fraction of these photographs are either releasable or of any interest to the public as a whole.

Photography is now used for training, publicity, historical record, identification, entertainment, reproduction, recruiting, mapping, observation, spotting, reconnaissance, analysis, and phototriangulation.

Its technical uses include X-ray, high speed flash, microphotography, photomicrography, detection, gamma-ray, and cartography.

These are the actual types of photography employed by the navy today: Aerial,



ground, color, lantern slides, slide films, portrait, wet plate negative, dry plate negative, transparencies, animation, photostats, stereopairs, reversal process, multilith, lithograph, blue printing, brown printing, off-set, X-ray, infrared, ultraviolet, and spark flash-stroboscopic.

Photography is used in the navy not only to acquaint the public with what the navy is doing, but it is also used to record fleet maneuvers for tactical studies, to capture the flight of projectiles, and their ability to penetrate armor plate, to make photographic records in color or medical research work, to provide progress records of the construction of ships and yards and docks, and even to record the movement of the stars for the Naval Observatory that gives all of us our official time.

Compiling a day-by-day permanent record of tactics and training, photography is continually reaching new dimensions. The camera—still and motion—records test flights and accurately shows mistakes and possibilities for improvement in the operation of navy planes. It is invaluable

in tactical work, allowing officers an opportunity to study in minute detail the actual operations of maneuvers and real engagements. In addition, photography long has been known for its value in re-

Her guns still pointing defiantly skyward, the U.S.S. Yorktown has come to the end of its gallant cruise





This 50-power spyglass of German make, with camera attachment for making photographs at great distances, was confiscated from a Japanese alien in Hawaii after Pearl Harbor. Now it's on watch for Japs

connaissance and it is rapidly becoming one of the most highly desired mediums for the training of personnel. Today U. S. Navy photographers are scattered all over the earth, compiling a day-by-day record of operations, training and battle heroism.

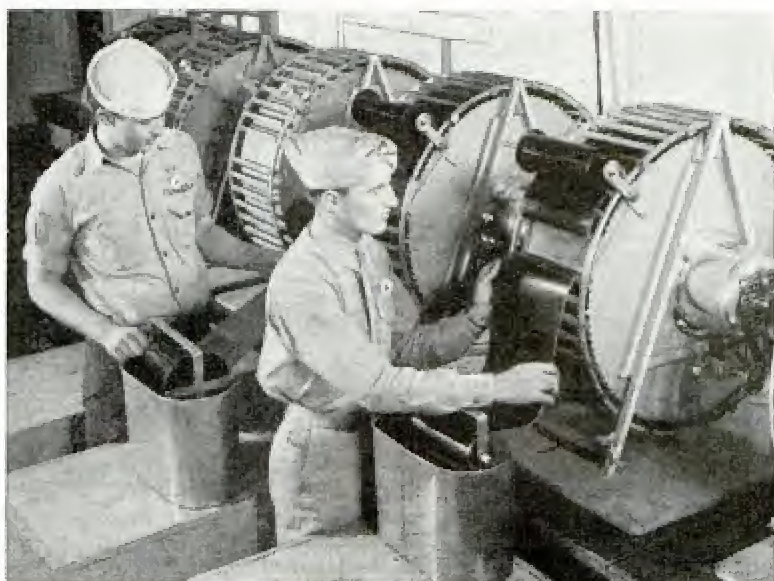
One interesting angle is the use of slow-motion movie cameras to solve some of the mysteries of the operations aboard aircraft carriers, which are not only comparatively new, as navies go, but include continuous innovations that increase efficiency. Many of these operations, such as those dealing with the takeoff and landing of planes, occur at a speed too high for the eye to register. The slow-motion camera became the detective which ferreted out the mechanical secrets. It is safe to say that the precision now attained in Navy carrier work could not have reached the highly efficient stage it now enjoys without benefit of these pictures.

The photographers who operate these complicated motion picture cameras have become so proficient in diagnosing the qualities of an aircraft landing that it has become an axiom in carrier operations that if a pilot, in making his ap-

proach to a landing, sees the motion picture operator start grinding out film, he had better prepare for a crash landing.

Modern warfare has brought a radical change in photographic reconnaissance. Multiple cameras are now installed, for both vertical and oblique photography, in fast-moving fighter aircraft which are stripped of everything except gasoline and cameras and can outfly any other plane in the air. The pilot is usually the photographer. Exposures desired are pre-set on the ground and the pilot, by remote control, takes the exposures with electrically operated cameras. Altitudes flown are generally 25,000 to 35,000 feet.

(Continued to page 156)



Drying aerial camera film in automatic driers, Naval School of Photography, Pensacola, Fla.

Record Disk Made of Glass Saves Critical Material



Recording disk made with glass base is transparent

Recording disks for home or studio use are being manufactured of a transparent glass base, developed to replace the conventional type of disk formerly made of materials now restricted because of the war. Manufacturers assert the glass disks provide high-fidelity reproduction, and declare the smooth surface of the new disk provides the lowest "scratch level."

Pressure Clip Keeps Blade Flat While It Is Being Honed

Cutting edges of a safety razor blade are kept at a constant pressure against the



Clip keeps constant honing pressure on razor blade

honing stone by a metal clip lapped around both ends of the stone and curved to follow the curve of the stone itself. To sharpen, a blade is inserted endwise under the pressure clip, held at the end by the thumb and forefinger, and stroked back and forth in a straight line. The clip slides over the end of the honing stone to permit cleaning of the stone.

"Pliers" Free Corroded Cables Frozen to Battery Post

Badly corroded battery terminals can be removed with a tool operated like a pair



Pressure lifts corroded terminal from battery post

of pliers. Pressure on the handles exerts power to lift any type of terminal straight up. The tool is especially handy where battery posts are not easily accessible for applying leverage by ordinary tools.

Beverage Mixer Keeps Ice Apart And Pours Undiluted Drink

When iced beverages are shaken in a mixer and allowed to stand, the last glassful to be poured often is so diluted by the melting ice that it is unpalatable. A shaker patented by Charles T. Jacobs of New Providence Township, Union County, N. J., avoids this dilution by means of a partition in the mixer. Ingredients and ice are shaken together, but then the partition, or septum, separates the ice from the beverage, permitting the ice to melt and keep the drink cool, but preventing dilution.

POPULAR MECHANICS

2,308,657

26 Kenro Prods. Inc
176 42 St, n.y.c.

H. & A. Selmer
Eckhart, Ind

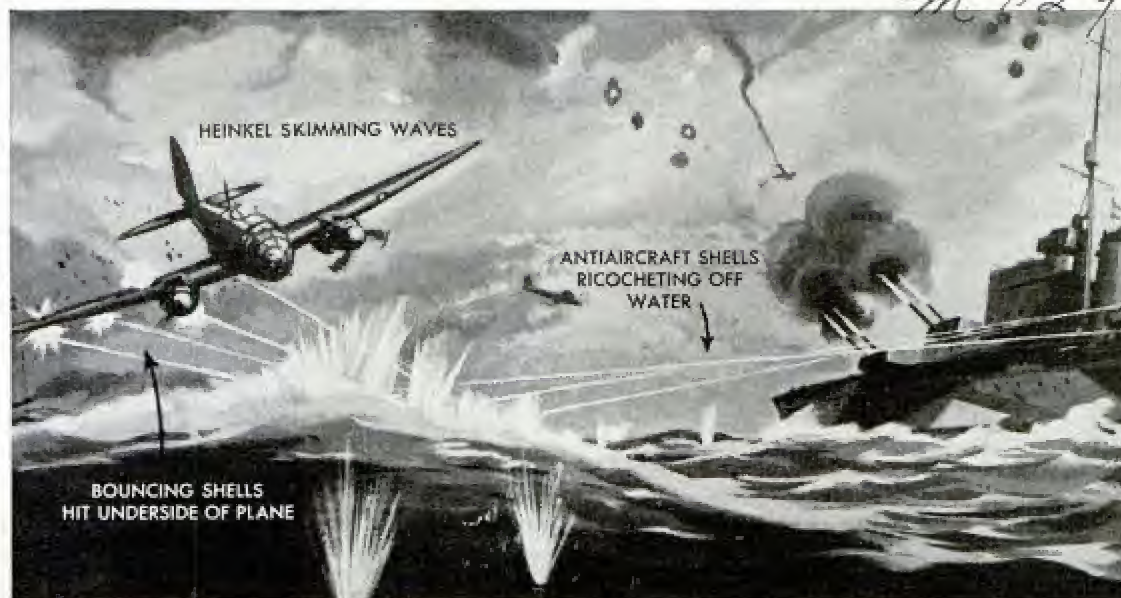
7140

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new Britain Machine Co.
new Britain, Conn.

758

7163



Bullets bounce off the sea (top) to rip fuselage of a Nazi plane; below, circling torpedo used by Germans

Low-flying German bombers that attack ships in convoy are met with a stream of tracer bullets that appear to come out of the sea. When a diving Heinkel or Junkers comes in skimming the white caps to avoid anti-aircraft fire, it is given a surprise reception by British gunners. Oerlikon guns are so ranged that the shells ricochet off the water and strike up into fuselage and cockpit. An innovation used by the Germans in their attacks on merchant vessels

is the "circling tin fish." Torpedoes are dropped from a high altitude and set to travel in circles which become smaller and smaller. Great skill is required in the launching so they do not circle short or beyond the targets. The wind carries many of them miles away from the convoy.

¶To produce enough gunpowder to fire a rifle bullet, about two ounces of alcohol are required.

Cont: Thomas E. Timson, Jr.
3872 Franklin Ave, Los Angeles Cal.



HOLLYWOOD'S ANIMAL ACTORS

M 1005

WHEN a Hollywood movie director wants to inject a little humor in a picture he is apt to phone the Twiford brothers.

"Curley," he may say, "how about a shot that shows a raven flying up to a mantelpiece, picking up a key and delivering it to a monkey on the floor, and then have the monkey unlock a cage full of chipmunks?"

"Sure," Curley Twiford responds, "Jimmie the Raven and Junior the Monkey can do an easy scene like that. And if you like, I'll bring along a couple of de-odorized skunks to play around on the floor."

Jimmie the Raven seems almost human when you watch him pick things up on command and place them where you wish. He puts a cigarette in your mouth, combs your hair with a comb held in his beak, wears suits, and sometimes is made up with arrangements of feathers to resemble an outlandish tropical bird. Junior the Monkey is just as clever. He carries objects and gives them to you on command, rides other animals, and even helps train other animals for their motion picture parts.

Aladdin of the Gay Lion Farm (top) was trained to walk on overhead cables for the movies. David Twiford's monkey "Junior" reaches for fruit in glove. Thread controls movements



Training animal actors for the movies is one of the world's oddest occupations. An animal man never knows, when he gets a call, what new stunt his animals are to be asked to do. Sometimes days can be spent in rehearsal; other times a trainer must extemporize a way to get an animal to perform at a moment's notice.

Curley and David Twiford, who specialize in "motion picture trained wild life" will provide anything from buzzards and bullfrogs to howling wolves for the studios. They start out by winning the



Curley Twiford rehearses his wolf to howl on a silent signal by hand for the sound movies



Rehearsing a twenty-pound eagle to rest on trainer's bare arm without taking a pound of flesh

confidence and affection of their animals as the first step in getting them to perform. Some animals can be trained to do what is wanted, others must be tricked into doing it by working on their natural instincts.

For instance, they can rehearse a skunk or fox to follow a certain path in front of the camera because these animals are creatures of habit. But they can't train a vulture to fly always in a desired direction in front of the camera. So the Twifords trick the vulture into doing what they want by placing another vulture out of camera range at the spot toward which they want the "acting" vulture to fly. Naturally the bird in front of the camera flies over to join its companion when it is re-



A skunk is made to hide under chair by attracting it with animal scent



Teaching a squirrel to hold up its head and tail at the "alert" when offstage command is given

"Jimmie the Raven," an intelligent actor, places a cigarette in trainer Curley Twiford's lips



Ronnie Renfro, movie dog trainer, with "Daisy" and his five trained pups awaiting their cue



leased, giving the cameraman the exact shot he wanted.

You can train a monkey to open a pocketbook simply by letting him imitate the way you open a pocketbook, but you can't train an owl to face always in the direction you wish, for picture purposes. Here again the Twifords use a trick to make the owl respond. Out of camera range they turn the breeze of an electric fan toward the owl. Like most other birds, the owl instinctively faces into the wind.

Simple little things like that are often the basis of a difficult effect.

When R.K.O. was filming the "Cat People" the director wanted to show that the human heroine had a catlike nature that animals instinctively recognized. A sequence was planned in which the heroine enters a pet shop and at once all the animals in the shop become excited and alarmed, quieting down at once as soon as the actress left again. How to get all the animals excited at just the right time was a problem that was solved by placing a duplicate set of animals alongside the set, out of camera range. The off-stage animals were in hooded cages and these hoods were removed and the animals were stirred up at the moment the heroine entered the shop. Naturally, the animals in front of the camera reacted too, and they didn't quiet down until the off-stage animals were hooded again at the time the actress left the shop.

Most people who own parrots are proud of their pets' vocabularies; yet David Twiford has a parrot that has never talked, but is far more valuable than the average pet. This is because a talking parrot is apt to speak out of turn while a sound picture is being made, an expensive mistake that his mute bird never makes.

Another of the Twiford feathered stars is Wilbur the Falcon, who stays steady on your arm until you wish him to fly, and then takes off in the right direction. The secret here is that the bird flies off when you drop your arm a little, and he heads toward his box where he knows some food is waiting. Big eagles are more difficult to train, yet one is so tame that it will rest on an actor's bare arm without digging its talons into the flesh. On location,

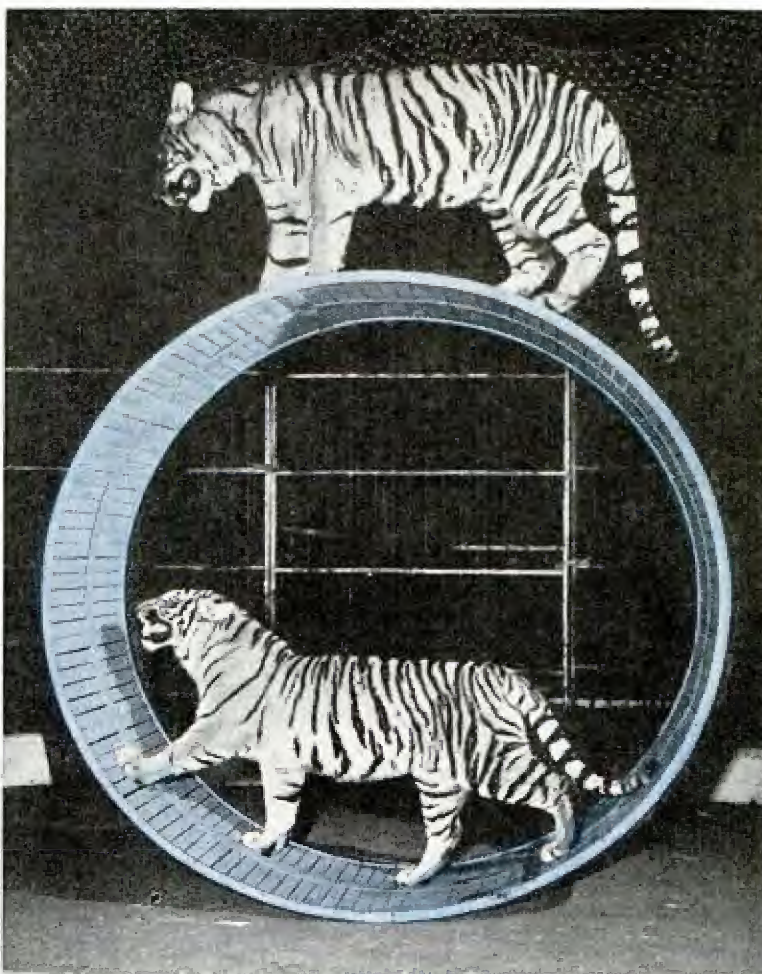


Photo from Ringling Bros. & Barnum and Bailey

These cats were trained to roll their hoop, walking opposite directions

Charles Gay with one of his movie lions walking cables in playful mood





Raven, dog and squirrel rehearse with Curley Twiford for a movie scene

small bells are tied under the eagle's wings so that it may be located by the sound of the bells if it flies to some nearby trees instead of returning to its cage. One spectacular picture showed a closeup of an eagle, high in the air, carrying a lamb to its nest. The aerial shot was made from one of the Goodyear blimps while the eagle was flying alongside, holding a rubber lamb in its talons.

No studio likes to chance having one of its human stars hurt or bitten by animals, so the Twifords use gentle specimens. Even

bees that the Twifords deliver to a studio won't sting. Once a studio called for 10,000 big ants that were to crawl over an actor's face in a "buried alive" sequence and the Twifords not only delivered the ants on schedule but guaranteed that they wouldn't bite. It was a sure bet, because the honey they smeared over the actor's face to attract the ants also kept the insects in a happy, stingless frame of mind.

Aside from the animal stars they own, the Twifords keep a list of other animals, birds, and fish owned by local people that they can rent for motion picture work. When

a studio calls for some wild animals that aren't on the list the Twifords usually can capture a few specimens. They know where to go in the mountains for wild lynx, they know what parts of the desert will yield kangaroo rats and snakes, and they know where to hunt skunks, taking along blankets to capture them without scaring the skunks into releasing their odor. They catch most small animals in box traps. Sea gulls are difficult birds to capture because they won't enter a trap or cage. So when a dozen or so are needed as atmosphere in a marine picture, David Twiford makes up some special snares of sponge rubber that



Still bottle babies, these two lion cubs on the Gay Lion Farm get an early start on their career as stars in Hollywood films

Looks like this owl has developed a bad cold. Twiford is teaching the bird to pick up a cloth rag while cameras grind

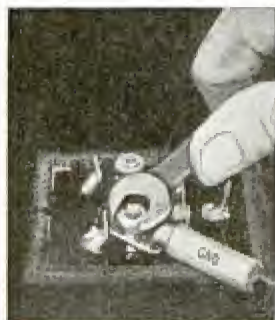


fasten over the hard part of the gull's bill without harming it. A permit from the state is necessary before gulls can be taken and the birds must be returned to their place of capture and released, after they have done their movie parts.

There are upwards of a dozen animal trainers who make their headquarters in Hollywood, some of whom possess menageries of circus size. Charles Gay of Gay's Lion Farm can supply lions on demand. Most lions are too dangerous to act with strangers, and too much time can't be spent to train a lion to perform a stunt that lasts just a few seconds on the screen. So the trainers take advantage of the lion's desire to return to his cage, when he finds himself in strange surroundings. When a director wants to show a rider leaping from his horse in the nick of time to escape a lion that has sprung from a tree, the scene is rehearsed a couple of times with a dummy wooden horse. A runway of invisible wires is placed in the tree and the lion's cage is placed just beyond the dummy horse, out of camera range. When the lion is released in the invisible runway he naturally leaps down to the horse, using it as a stepping stone to reach his cage. When the scene is played for the camera the lion pays no attention to the rider who has just leaped from the horse in obvious terror, but the effect on the screen is one of nip and tuck action.

Some animal actors command high salaries. Daisy and her quintuplets, the dogs that appear in some of Hollywood's comedies, are insured for \$50,000. Actually, Daisy is a male but was given the feminine name by Baby Dumpling of comic strip and motion picture fame. Ronnie Renfro, owner and trainer of the dogs, originally paid \$3.00 for Daisy but since then she, or he, has become so valuable that Renfro was glad to pay \$500 for a double for the dog.

Plastic Tube Insulates Wire And Carries Identity Tag



Tedious sorting of wires to make sure the proper one is attached to the proper terminal is avoided by marking identifying letters or numbers on extruded plastic tubing, which also serves as an insulator. The marking is said to be resistant to chemicals, water and oil.

87

JUNE, 1943
+ Invenator Co.,
Irvington, N. J.

Ref: Fleetwings Inc Bristol, Pa. Electric Mouse Winks Eye To Tell If Line Is Straight



Electric line-marker below replaces both tools above

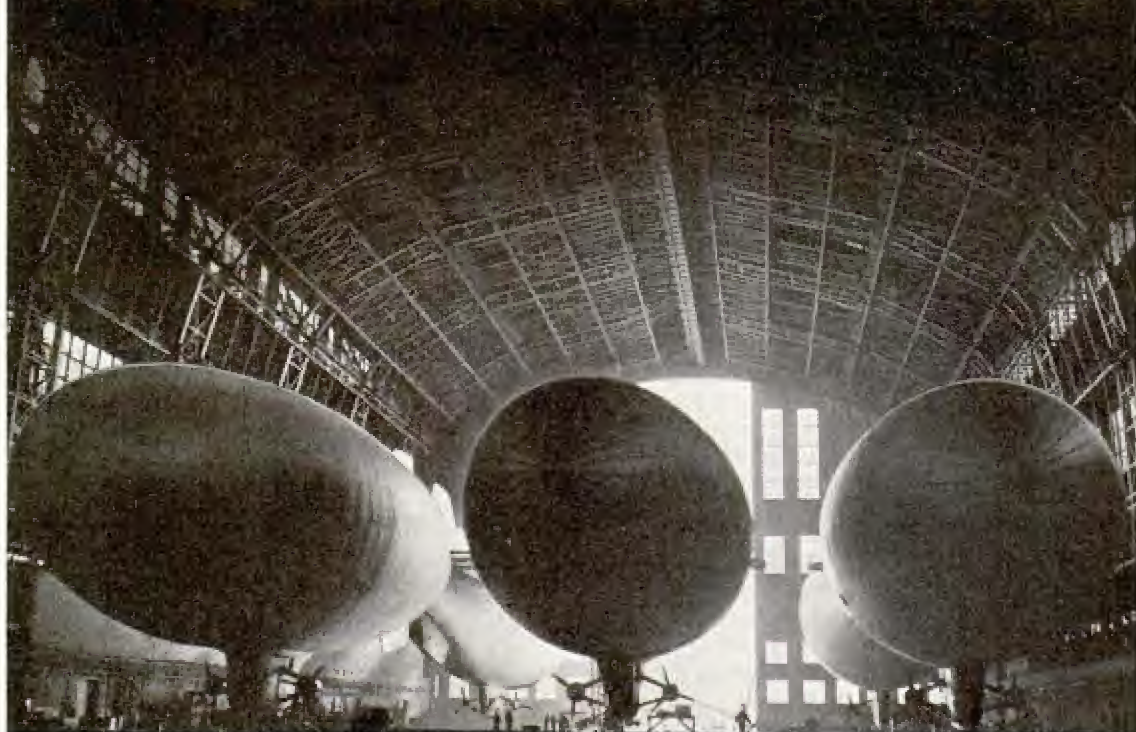
Draftsmen working on a lofting table may have to draw a straight line as long as the loft itself. As a guide, a length of piano wire is strung, and points marked by pencil along the wire are later connected by drawing along a straightedge. To locate the points without deflecting the wire, the old method was to move a square against the wire, peer through a magnifying glass to assure that the square just touched the wire, then mark the point. With a battery-powered "electric mouse" the points may be marked more quickly. When the "mouse" is pushed against the wire a flexible whisker closes a circuit and lights a bulb. The "mouse" is then slowly withdrawn until the lamp flickers, showing that the guide wire is no longer pushed out of true. At the spot where the light flickers, the point is marked.

Fiber Container Resists Vermin

To replace metal cans as containers for garbage, refuse, ashes, fruits and vegetables, there is a 20-gallon fibre receptacle which is water-resistant, verminproof and durably built. All seams are made with heavy flat wire stitching to assure strength.

Arney Corp. 33
3462 N. Kimball Ave
Chicago 40

GAS BAGS *on* PATROL



38 *72* *35* *Lakehurst, N.J.*
 By Thomas E. Stimson, Jr.
72 Franklin Av. Los Angeles, Calif.
 Five Navy lighter-than-air craft nestle in their hangar, above. Below, a submarine's-eye view of a "K" ship on sea-lane patrol

LANDING a big Navy "K" ship isn't as easy as it looks. It seems simple when you watch the blimp float gracefully down to the landing mat. Actually a smooth landing is a precise operation that sometimes takes all the skill that the airship commander possesses. From a dozen different landing procedures he must select the method best suited to the existing temperatures, the speed and gustiness of the wind, and the present weight of his ship.

By the time he receives the radio message that the landing party is ready for him he has already tested the ship's weight by pointing it into the wind and idling the engines. If the blimp is heavy it sinks; if it is light it begins to ascend. He pumps air into the forward or aft ballonet to assure good elevator control, lets down the retractable landing wheel, and slowly flies down to the landing circle.

Sometimes he lands the ship on its wheel and taxis up to the flagman; other times he "lands" in the



air above the landing party and drops the long handling lines. Then, after the ground crew has slowed him down and steadied him into the wind, he uses his engines to fly down to the ground. Constantly he is on the alert. Hot air above a brown field over which he must approach may cause him to "fall through." If the helium in the gas bag is hotter than the air at the ground, the airship may try to rise out of the hands of the ground crew after it has landed. A strong gust of wind may turn the ship's nose up or to one side at the last moment. The airship commander knows what to do in any case.

Airship operation is far beyond the stage of fair weather trials today. Thanks to lighter-than-air research that has been quietly going forward during the last decade, the nonrigid airships that the Navy is using on coast patrol are sturdy vessels of the air that can do their job in almost any kind of weather. The blimps are our best antisubmarine weapon for the protection of both coastal shipping and convoys. No convoy has been successfully attacked when provided with blimp protection.

The airships can drop depth charges with unbelievable accuracy. They can lie motionless in the air or descend to low altitude to study suspicious objects at leisure. They can rendezvous surface craft or shore-based airplanes to the spot they are hovering over.

Some features of lighter-than-air operation seem strange to those who are more familiar with airplanes. An air-



One important member of the blimp's seven- or eight-man crew is the navigator, seen above as he leans from car window to take drift sight

In the transparent plastic nose of the car sits the bombardier, his glasses trained on the ocean. Behind him are the pilot and co-pilot



air yet it is not an easy aircraft to fly. The pilot is constantly at work, relying on his sense of feel to anticipate the effects of each gust in order to meet it with the controls. He has no automatic pilot to help him. Flying under a cloud often reduces buoyancy for the time. Meanwhile, the ship gradually becomes increasingly light due to reduction of its fuel load. Even a change of humidity is reflected in the way the ship handles and flies. Whenever the airship encounters a new temperature area there is for a time a difference between the outside temperature and the temperature of the gas, and the "superheat" thus created causes more work for the pilot.

The men who go out on anti-submarine patrol get little pleasure cruising. Even in quiet weather the job is an exhausting one. Storms and gusty weather are not hazardous but the crew gets tossed around under the swaying bag. Riding in the car in rough air is almost as bad, they say, as riding a destroyer through heavy seas. Rain does not deter operations though it adds weight to the bag. Snow or ice result in increased load and the blimp must release ballast to compensate for the weight. Our Navy blimps can and do operate in weather of zero visibility in which heavier-than-air craft are usually grounded. They have been known to take off in dense fogs without mishap. On occasion when their station is fogged in they have found their way home by flying right along above a highway, turning off at the right intersection to reach the field, and dropping the handling lines to an almost invisible crew below.

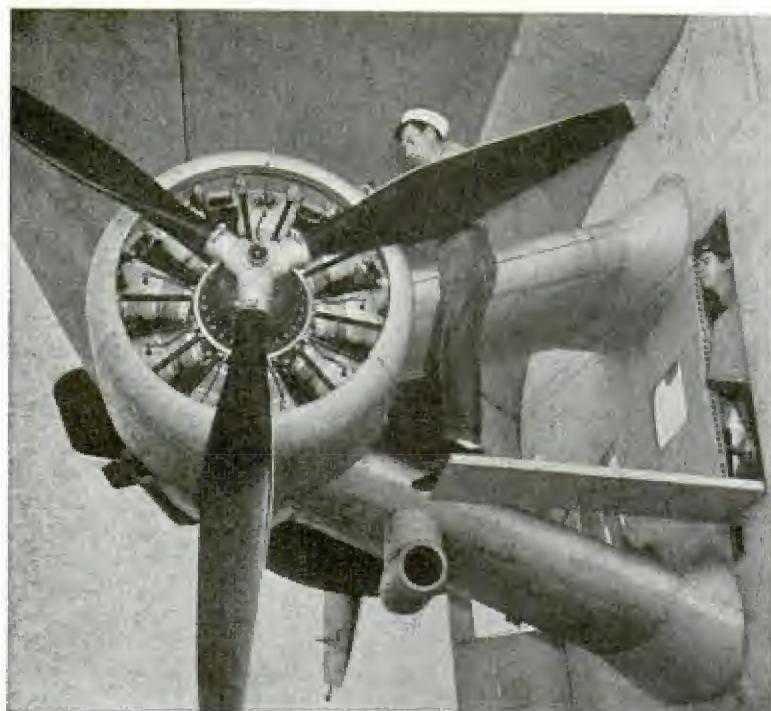
Our modern blimps of the "K" type are several times the size of the familiar Goodyear lighter-than-air ships that have been in operation for years. The "K" ships carry a crew of seven or eight men, not all of whom may be on watch at the same time. Inside



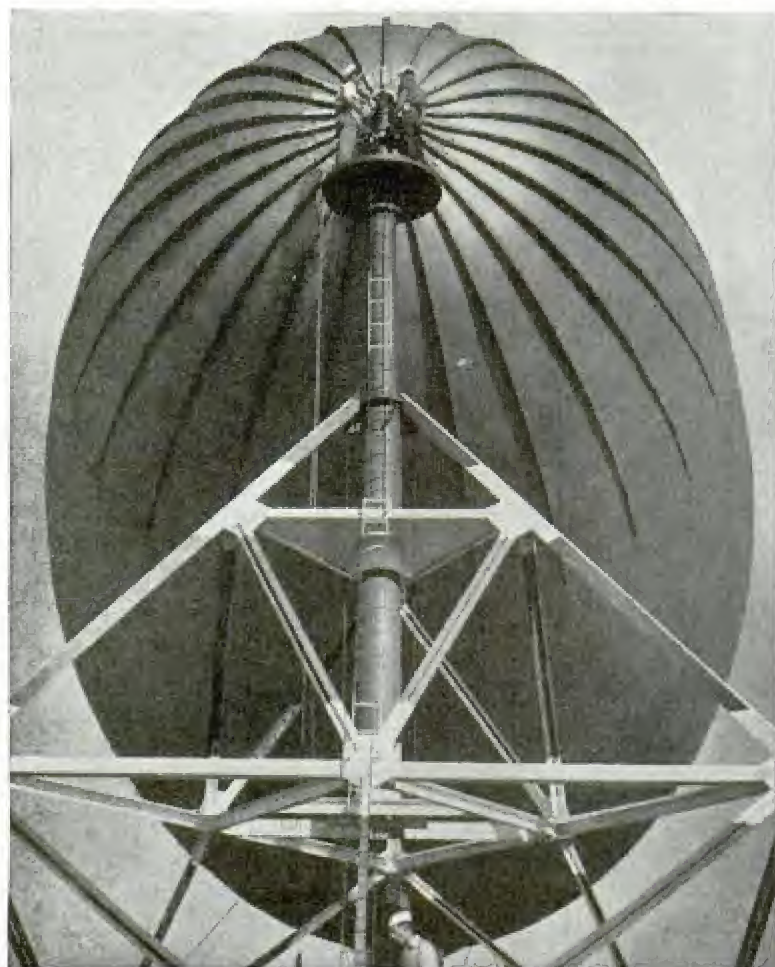
High above the sub-infested Atlantic, watchers aboard a blimp car constantly scan the sea with their glasses for the tell-tale plume of a periscope or the shadow of a submerged U-boat

Portable mooring masts have made the blimp independent of the home hangar. Here a "K" ship is moored for the night
U. S. Navy photos





Above, a mechanic "walks the plank"—a catwalk that drops from the wall of the blimp car for servicing engine in flight. Below, sailors at the top of a mooring mast make the ship fast



the lightweight car are bunks, a galley, and other conveniences for the crew members.

One favorite joke in the lighter-than-air service is about an early blimp commander who took an airplane pilot up for a ride. The commander climbed his blimp up sharply away from the field and then, with only a few hundred feet of altitude under him, cut off his engines. The airplane pilot froze while he waited for the inevitable and disastrous spin, until he realized that the gas bag above him was holding them safely in the air.

Blimps can ride out heavy storms on the ground as well as in the air. With the nose attached to the top of a sturdy triangular mooring mast they weather-vane behind the mast, riding back and forth on the landing wheel. Before the present strong masts were adopted a blimp pilot sometimes "flew" his ship at the mast during a bad wind-storm. Though actually on the ground, he kept his propellers spinning at cruising speed to help lighten the strain on the mast, just as the captain of a surface ship may steam ahead slowly during a bad storm in an exposed anchorage, to reduce the strain on his anchors and prevent them from dragging. Today the Navy is completing a number of major blimp stations on each coast and, in addition, is providing additional auxiliary landing areas where the blimps may refuel and take on relief crews.

The airships are setting a remarkable record for safety, yet one of the unsolved mysteries of the war concerns two lighter-than-air men who took their small blimp out to



Above, clamping expansion valve on back of helium tank truck preparatory to gassing blimp. Right, anemometer man (wind velocity) and flagman stand at the center of the landing mat as a blimp approaches

sea one day last year on the western sea frontier. The ship reported back to its station by radio, then failed to answer additional calls. At various times it was sighted by surface craft and airplanes, sometimes close to the water, sometimes high in the air.

Eventually it drifted ashore out of control and came to rest on a street. There was no one on board. The bag was partly deflated but the car was unscratched. All the gear was in its normal place and the radio receiver was on and operating. Engine ignition switches were turned on though the engines had stopped. Even the



hats of the two missing men were lying undisturbed in a rack. There seems to be no reasonable explanation as to what could have happened and to this day an answer hasn't been found.

Boots Joined to Inflated Tubes Form Russian 'Body Boats'

Wide stretches of water were no sure protection against forays by men of the

Red Army, Nazis on the Russian front discovered, because Soviet units equipped with ingenious "body boats" might make a foray at any time. Sappers, especially, could approach by stealth, and their presence might not be known until after they had set off their charges. The "boats" consisted of waist-high boots, attached to an inflated tube, and were propelled by paddles about the size of a table-tennis racket.

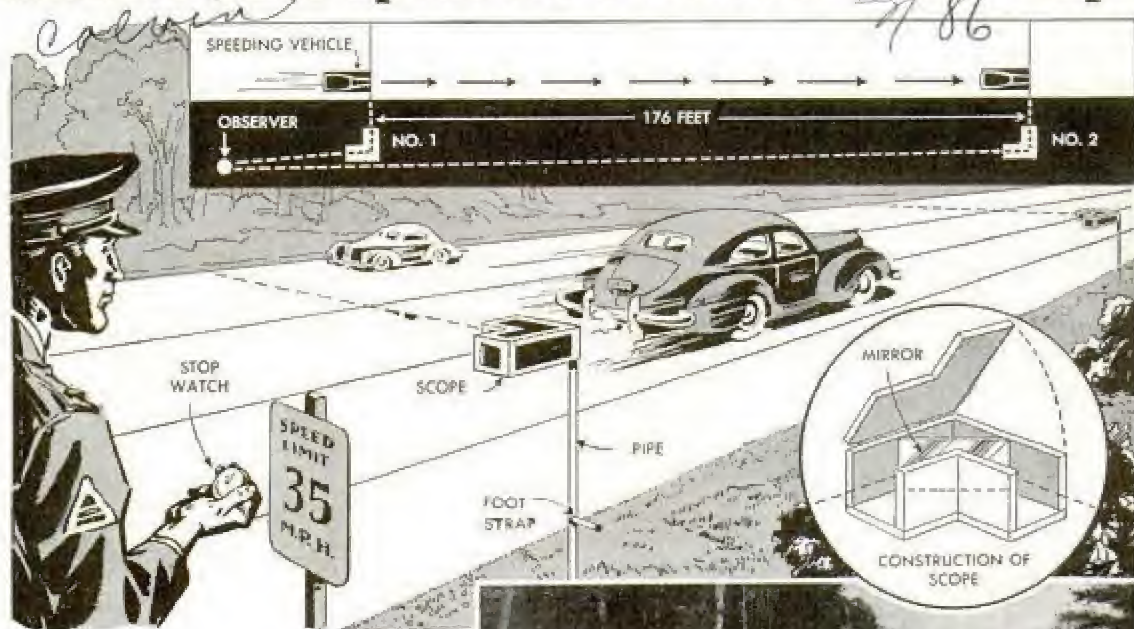


Red soldier can carry his rifle or other equipment behind back on inflated tube

JUNE, 1943

*Public Pictorial Service, 438 Ohio
(Sawfoto, 11 N 42, nyc.)*

Mirrors Time Speeders Over Measured "Trap"



Virginia officials have warned all motorists that the commonwealth will be a "speed trap" as long as it is necessary to enforce the 35-mile-an-hour wartime speed limit, and the warning has teeth, in the shape of low-cost timing devices. Since "electric eyes" were unavailable, the Virginia State Police utilized a device developed by the Eno Foundation of Yale University, costing only 75 cents to make. With these, a trooper may time a speeding car and flash a warning to a "catch" car to arrest the violator. The detector is an L-shaped box containing a mirror set to split a right angle. One detector is set at each end of a measured zone (176 feet in Vir-



Observer views car's reflection in each scope, and by clocking its progress across measured distance can determine its speed

ginia), so that the observer can see the image of the vehicle as it passes each detector. Stopwatch in hand, the observer snaps the car's elapsed time, and can tell its speed immediately from a prepared chart.

Navy's Amphibian Sailplane Carries 12 Men and Their Equipment

Answering the challenge of amphibious warfare such as the Japs unleashed in the

Southwest Pacific is a new Navy development, a sailplane that is at home literally on land, on the sea, and in the air. The amphibious glider, unveiled at an east coast naval aircraft factory, is capable of carrying a dozen men, fully equipped. Boasting a 72-foot wingspread, it is built of molded wood and other noncritical materials.



Navy troop glider is at home on land or sea or in the air

40 Built at Philadelphia Naval Aircraft Factory Philadelphia, Pa.

Cont: Thomas E. Stimson, Jr. 3872 Franklin Ave. Los Angeles, Calif

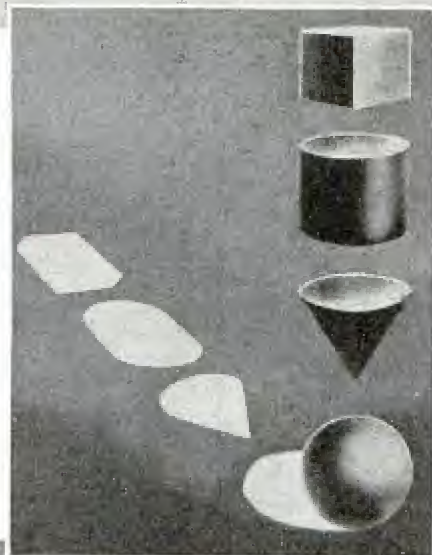
COLLEGE *for* INVENTORS



Draftsmen use special "scooters" at Lockheed Aircraft plant and roll around their work in odd poses — always shoeless

Burbank, Calif
Right, chart shows four principal shapes taught industrial design students as fundamentals in reaching finished design

Below, inspecting airplane wing type of roof for prefabricated home. Model of finished section is in the background

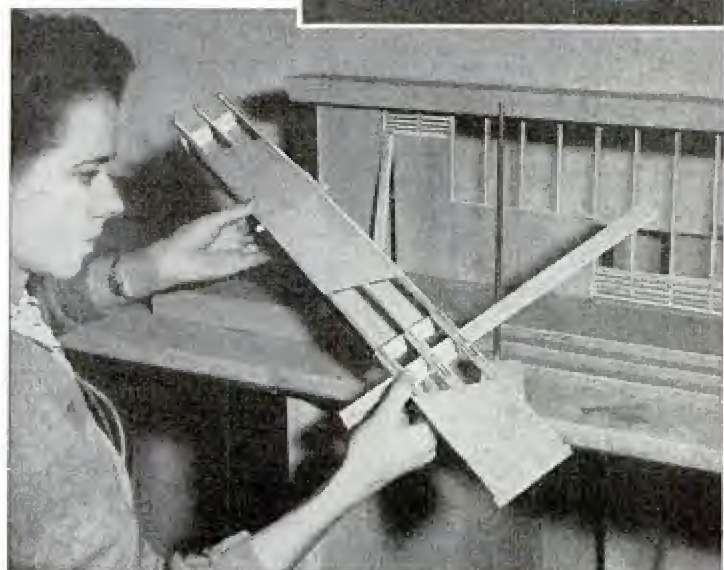


YOU feel pretty smug when you compare your present automobile or vacuum cleaner with earlier models in a museum, but do you think that even the most modern machines and gadgets are perfect?

Of course not. Two years or 10 years from now the things we use today will be badly out of date. New models, better, simpler, and more artistic will be on the market.

Improving and redesigning the things we use are parts of the profession called industrial design. This doesn't simply mean dressing up a radio set in a futuristic cabinet or "streamlining" an alarm clock. Industrial designers try to create objects that are more efficient in every way.

The fact is that at times all of us are industrial designers. Even such a simple thing as putting blocks under a table to raise it to a more efficient height is an example of the art. The war workers who suggest improvements for their tools or better ways to build airplanes are practicing industrial design. Employees of Boeing Aircraft Company have received nearly \$6,000 for time- and labor-saving

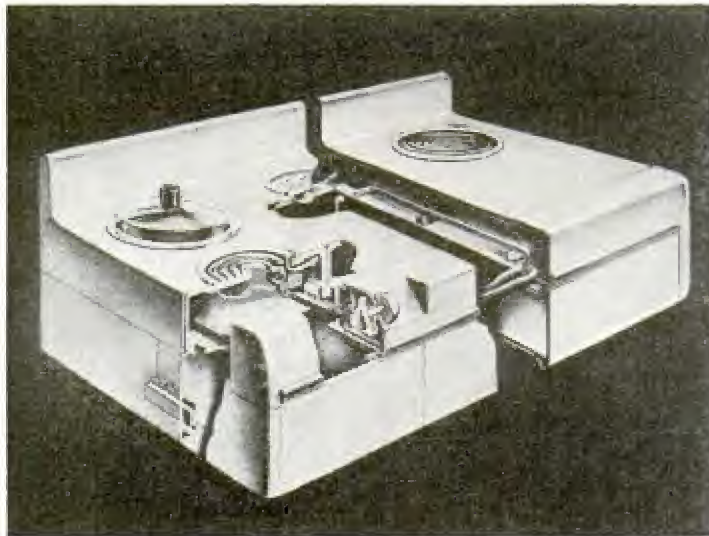


JUNE, 1943

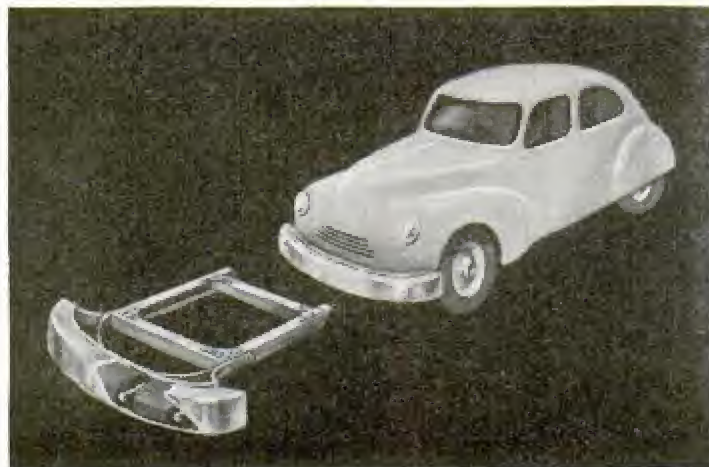
Ref: Antonin Heythum, Industrial Design Section, Calif Inst of Technology Pasadena, Calif.



Design changes aim at more efficient use. The perspective sketch used in aircraft plant, above, is more easily read than blueprint. The table-top electrical cooking unit (below) has a separate oven



Automobile bumper below was designed to absorb as well as deflect the force of a blow, thus protecting the car itself in a collision



ideas, some of which may be patented.

Industrial competition has reached a point at which manufacturers must constantly redesign their products to perform more service, do more things, or be desirable in other ways. In the past a manufacturer called in his engineers to do the basic work, then consulted a specialist in design to decide on the final appearance. Combining these two fields is the purpose of a new school that is part of the California Institute of Technology. Engineering knowledge is required so that the students can work out the practical mechanical details of the things they design. In most cases they build models of their creations, with drawings to show the technical details.

Students at Caltech's industrial design section don't start out by designing futuristic homes and automobiles. Whisk brooms or washing machines are more down to earth. First they have to decide whether changes are desirable in the object they are studying and they learn this by using the thing they are studying. Under the direction of Antonin Heythum, chairman of the section, one class had the problem of preparing an efficient plan for a kitchen. This commonplace subject was selected because it could have universal application and because many devices used in a kitchen could be improved.

No one can create a better kitchen until he knows the details of how a kitchen is used. So the first thing on the program was to visit and study various types of kitchens including those in trailers and dining cars. Next, food supplies were purchased and properly stored on shelves and in the refrigerator and cooler. A dinner was prepared, the table set, dinner was served, dishes were washed and the kitchen cleaned. Details of all these actions were analyzed, then

a kitchen arrangement was designed that provided for a minimum use of energy. This suggested a small room. Heights were selected that eliminate unnecessary stooping and stretching. Essential and most needed supplies were placed close to the working areas.

The general kitchen layout was prepared as a class project, then individual students worked out details. The student in charge of refrigeration found that the average refrigerator could be of smaller size if space were provided for a cooler unit as well. He placed the two units side by side, utilizing the leakage of cold air from the refrigerator to keep the cooler space at low temperature.

The student in charge of cupboards decided against storage areas that reach up to the ceiling or down to the floor. Upper and lower units were kept within comfortable reach. Open cupboard doors at head height are a hazard, so roller blinds of a smooth plastic material were provided instead. Plastic rods were substituted for the usual drawer handles, long enough so that any of them may be used as towel racks. A service table on wheels was designed for use in preparing and clearing the table, low enough so that it may be rolled out of the way under one of the kitchen table units when not in use.

The stove was designed as a table-top model with an oven that may be installed independently at a height that eliminates unnecessary stooping. The sink unit that seemed to be the most practical has two sections, one for washing dishes with the adjoining one for rinsing. For ease in dishwashing, a water-regulating device was desired that would allow simultaneous control of volume and temperature. This was achieved by a volume lever and mixing wheel combination that may be operated by one hand. The faucet itself contains an elastic hose that can be pulled out so that the water may be directed at the dishes. Either a

Lightweight chair has tilting back rest to adjust automatically to posture of sitter



Designer's own office desk has shelf spaces under its working surfaces

steady stream or a spray may be obtained by twisting the nozzle. All the engineering details of these units were worked out.

Another example of how background is necessary when preparing a design was provided by a different problem. The architectural design, including plan and equipment, of a bookstore was desired. First the class visited several bookstores to absorb ideas that have proved practical and also to ask the proprietors for im-





Plastic holders for book matches are cast six at a time. This half-dozen have not yet been separated



Lamp's plastic upright becomes a bookrest as lamp swings down

Wheel and lever control water's heat and volume on model sink

provements that might have occurred to them. Then an arbitrary location was chosen, on one side of a certain street in a certain community. Traffic flow, the class of trade, and shopping customs of the area had to be studied. Ordinances covering the use of the store area were consulted. Not until then were the students really prepared for the problem.

Other ideas that have been developed by the design section include a lightweight corner lavatory for air liners, using pushbutton controls for water. A door handle that unlocks the door when you push it down instead of twisting it was devised by one student, while another developed an airplane wing type of roof, skin stressed, for use in building prefabricated homes.

Students also have designed an automobile bumper that protects the car by deflecting as well as absorbing the force of a blow. They have worked out the de-

tails of an improved electric food warmer, have studied various desirable shapes for glass pitchers and other utensils from which liquids are poured, and have created an inexpensive chair of modern design with a padded back rest that automatically tilts itself to fit the contours of the person using it. Street light reflector shades that reflect all the light into the street area without shining into adjacent bedroom windows was another problem.

One of the first problems that the design section tackled was that of designing and building furniture for its own working quarters. Ordinary drafting tables were too small and of the wrong height for the work, so better ones were created after working tests had been made.

Wartime living has its effect on the curriculum and one recent research project had to do with studying suitable ceramic replacements for metallic objects. One result of this is an improved design of ceramic grate to take the place of the usual cast iron grate used in fireplaces. Sturdy enough to be practical and of a simple three-piece design, the grate has a curved fire basket that may be tilted to throw maximum heat.

Of course, graduates of the school are not expect-

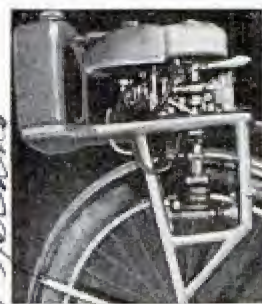


ed to become leaders in every kind of design. Each who enters the profession will specialize in some part of the field, yet the all-around instruction that they receive in school teaches them fundamentals that apply to all fields. Their studies include courses in design techniques and design trends, shop practice, use of nonmetallic materials, materials and stresses, business economics, social and buying psychology, and cost analysis. To give them a wide grasp of all the problems of design, they are asked to do research for such varied problems as preparing displays that would popularize an adequately balanced diet within the limits of the food rationing plan, and to design displays that promote the sale of war bonds. In some cases they prepare advertisements that would help "sell" the things they have designed.

The old saying is that the world is always looking for a better mouse trap. Now instruction on how to go about designing a better mouse trap has been put on a scientific basis.

Water-Cooled Motor for Bike Gives 70 Miles a Gallon

With the core of an auto heater and an automobile oil pump, Donald Laverdiere of Waterville, Me., water-cooled an outboard motor for his bicycle. He claims a speed of nearly 30 miles an hour and fuel consumption of only one gallon of gasoline per 70 miles traveled.



Outboard motor's water jacket is from an auto heater

Baby Rides Like a Papoose While Mother Shops



Papoose pouch solves buggy shortage for this mother

Gasoline is rationed and baby buggies are hard to get, but Jacob Karro of Arlington, Va., solved his wife's problem of carrying the baby while shopping by devising a pack, carried by straps around his wife's shoulders, in which his baby son is carried in the traditional papoose style of Indian mothers. The pack leaves the wife's hands free to carry the groceries, and the baby appears to enjoy the backwards ride.

"Silent Fireman" for Warplane Borrowed From Electric Iron

Wartime duty of a little metal disk that might have controlled temperature in a housewife's electric iron is the protection of warplanes from fire. These disks are thermostats, about the size of a silver dollar, being turned out by the thousands by Westinghouse. When fire starts from tracer bullets, a leaking gas tank, or overheated engine, the high temperature moves the bi-metal disk slightly, closing an electric circuit which causes a light to flash on the pilot's instrument board. At the signal, he pulls the appropriate lever to release fire-quenching carbon dioxide.

*Capt. J. P. Leggett, 22 on 7ar
Hells Art, Oakwood, Dayton, Ohio*

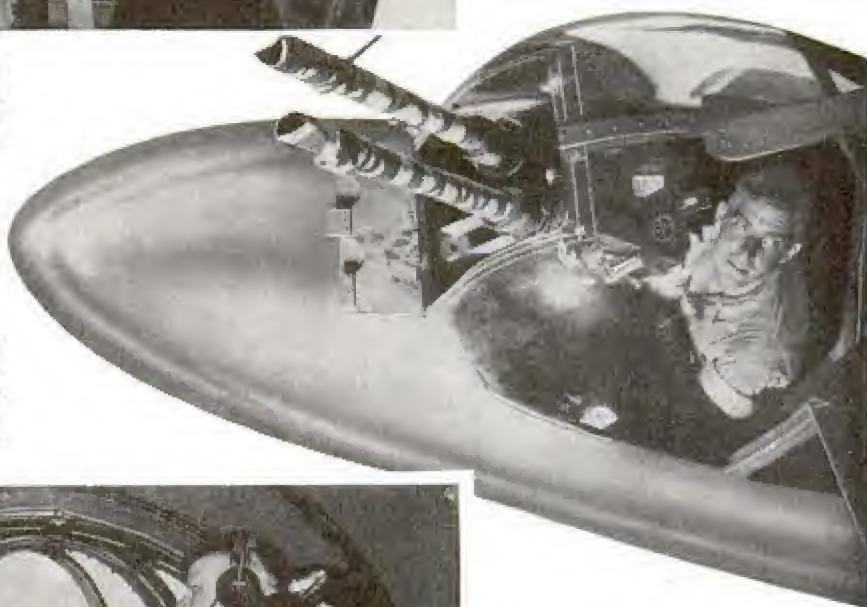
TRIGGER MEN of the BIG



The gunner's office on a Flying Fortress is always open for business, ready to deliver 50-caliber messages to Jap or Nazi

Another "trigger man" in the tail of the bomber offers a double sting to visiting enemy fighters

Here's an inside look at one of the gunners, showing how his weapon revolves to follow target. Notice inter-office phone



77 1043
IT ISN'T just luck that Yankee bombing planes are striking deep into enemy territory on half a dozen fronts and returning safely to their bases, even when unescorted by fighter craft.

Several factors are involved, such as the skill and resourcefulness of the pilots and the sturdiness of those big ships. But much of the success of the Flying Fortresses when pitted against German Messerschmitts and Japanese Zeros must be credited to the quick-thinking, fast-shooting gunners aboard the bombers.

Certainly, it wasn't luck that the gunners of Major

Wheless' Fortress shot down 18 Zero fighters during that famed raid on Jap bases in the Philippines; nor luck in dozens of other raids in which the gunners of American bombers have fought off enemy attackers and enabled the pilots to bring their ships safely home. Instead, these successes can be attributed to the training and courage of aerial sharpshooters.

Let's take a look at Uncle Sam's largest Army Air Forces Flexible Gunnery

POPULAR MECHANICS

BOMBERS

School in Florida and find why American flying gunners are the world's best.

Right at the start, we discover that the gunnery student is a hand-picked man in every sense. No matter how he entered the service, he becomes a gunner only by his own volition—he must volunteer.

At the gunnery school, the course of training occupies five

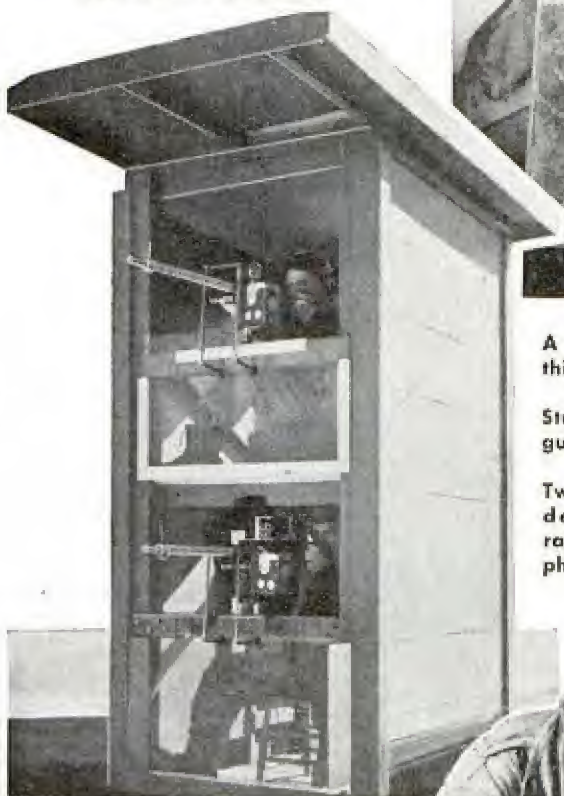
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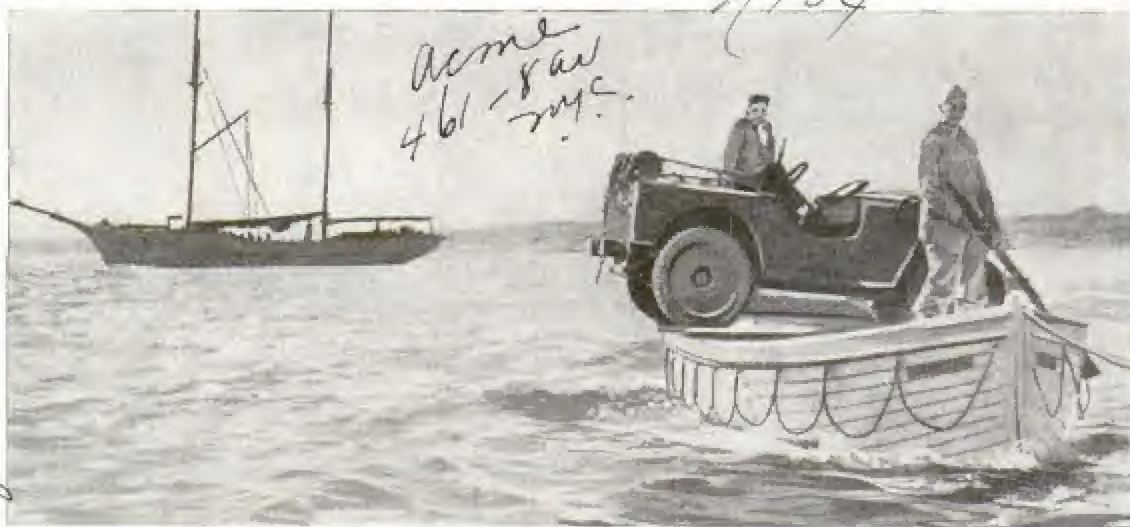
A deadly stream of fire awaits the fingertip touch of this flying gunner, looking down sights of a Browning

Student gunner (below) must be able to put his machine gun together blindfolded, to be ready for night fighting

Two aerial gunnery students (left) practice rapid fire from "telephone booth" on range



Jeep Rides a Boat "Side Saddle" to Landing



Straddling a small boat, jeep is ferried ashore on island in South Pacific to be used for reconnaissance

In a new example of its rugged versatility, the Army jeep has virtually gone amphibian. For a recent landing on an island near New Caledonia, where it was subsequently used for reconnaissance, the jeep was ferried ashore on a boat not much big-

ger than itself. Though longer than the boat's beam, the jeep was neatly balanced on supports set across the gunwales. Arrived at the beach, the mechanical jack-of-all-trades was quickly unshipped and sent on its scouting errand.

Mechanical Fingers Can Clean a Chicken in 10 Seconds

Even the pinfeathers are stripped from fowl by a mechanical picker, designed to facilitate the marketing of poultry as a substitute for rationed meats. The machine, a revolving drum with mechanical fingers, eliminates the time-consuming job of picking feathers by hand, and strips the birds clean in 10 seconds, at an estimated cost of 2 to 4 cents a bird.



Even pinfeathers are whirled away on picker's revolving drum

R.A.F.'s "Ticklish" Bomb Joins War on Axis

Lifting a long-imposed veil of secrecy, the Royal Air Force has disclosed its use of two devices that mean headaches to Hitler and Hirohito—one, a radio "eye" that can spot an enemy vessel on the darkest night or in the thickest fog, the other a delayed-action bomb that explodes immediately if any attempt is made to remove it before the time it is set to go off. The radio location device can detect the approach of planes or, installed on warships, can discover the position of surfaced submarines or other vessels, and plot their courses.

Bombs Spun Like Potter's Wheel Shapes Clay ^{Colvin} ₇₋₁₂₋₄₀

By borrowing a technique from the ancient skill of the potter, American industry is stepping up its production of that most formidable of modern weapons, the giant aerial bomb. Bomb casings are "spun" in the United States Steel Company plants much as the potter uses his wheel to form clay. A white-hot steel tube, whirled at high speed, is

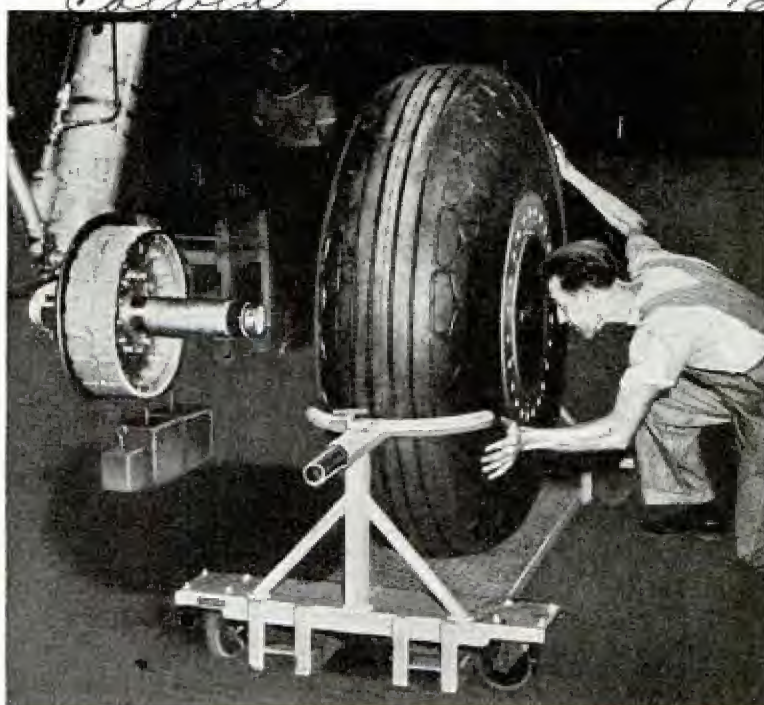


Glowing bomb casing above is shaped as a potter's finger shapes a vase. Below, carrying lugs are welded to casings

quickly shaped into the nose and main body of a bomb by a huge arm, which swings into position to mold the revolving tube. Other machines, by the same method, shape the tail portion of the bomb. Once shaped, they are finished, threaded, fitted with welded carrying lugs, painted and shipped to loading plants on the next leg of a journey that will climax in a plunge from one of our big bombers toward an enemy target.

One Man Installs Flying Fortress Wheel With Dolly ^{Colvin} ₇₋₁₂₋₄₀

Although the wheel assembly for a Flying Fortress weighs a quarter ton, one man can readily install it on the hub of the landing gear because it rolls into place on a dolly provided with clamps at each end to hold the wheel steady. The dolly is about the same height from the floor as the rack on which such wheels are stored. Several dollies, mounted with wheels, are towed to the final assembly area at the Boeing plant, and left near the point of installation. A workman trundles each to its waiting hub.



Bomber wheel weighing a quarter ton glides into position on one-man dolly

☞Horses rest better—actually use up fewer calories—when standing than when lying down, metabolism tests show.

used by Boeing Aircraft Co. Seattle, Wash.

OLD MAN RIVER GETS *in the* FIGHT



Excursionists crowd the decks of the sternwheeler "Golden Eagle." Few of the picturesque old packets remain

By Roderick M. Grant

WAY BACK when Old Man River was a kid, his was a very gay and romantic life. Plantation melodies hung over the murky Mississippi as showboats paddled up from New Orleans and palatial side-wheelers floated the frontier gentry down to that capital of the valley. Traveling salesmen bringing calicoes and bonnets and fruits of the civilized East rode the

packets into every river landing. Black smoke and a whistle booming importantly raised the cry "Steamboat 'round the bend!" and farmers and merchants and darkies ambled down to watch the fabulous J. M. White sidle into the dock, freighted with 5,000 bales of cotton.

Old Man River is a gay blade no longer. He has grown up and gone to work. What the fancy little twin-screw towboats of 1943, with their air conditioning and their purring Diesels, lack in glamor they make up in hard work.

Almost unnoticed in the turmoil of war, river and canal traffic in the United States has climbed past the 100,000,000-ton mark. It had already grown to gigantic stature before the war, for in 1940 the Allegheny and Monongahela alone floated 33,488,641 tons of cargo and the Ohio 30 million more—their total matching the shipping of Suez and Panama canals combined. The premier river port, Pittsburgh, had risen to a place sec-



From the roomy, comfortable pilothouse of a Union Barge Line towboat the pilot watches over his string of barges

Captain of "William Penn" arranges templates to plan best distribution of barges
Dravo Corp. photo

ond to New York alone in waterborne tonnage. Ugly, unspectacular, squat barges with ravenous appetites for cargo ply up and down from Minneapolis and Pittsburgh to the Gulf, from Corpus Christi by intracoastal canals to Florida, and up the protected waterways hidden behind the coastal dunes from Miami to Trenton.

Beside the barges, an ocean freighter seems a puny thing. From a hilltop along the scalloped Ohio you can watch a toylike towboat shouldering (towboats never tow) a 15,000-ton "train" of barges against the current. Single barges run up to 280 feet long—nearly the span of a football field. Welded hopper barges carry as much as 1,000 tons of coal, and fleets of tankers laden with 6,000 to more than 9,000 barrels of gasoline and oil are right now climbing the steps of the Ohio to feed a fuel-hungry east. A towboat and its brood of barges sometimes stretches beyond 900 feet, a feat in power and navigation that would stagger the shoal-dodging pilots of Mark Twain's gilded era.

One unpretentious but muscular

Notice two "missing links" on map of waterways that circle eastern states. Below, a Socony-Vacuum towboat hurries upstream with a big load of gasoline for the east



Builders: Sturgeon Bay Shipbuilding & Dry Dock Co., Sturgeon Bay, Wis.

1803 W. Ohio St.
Evansville, Ind.



Prewar souvenir—a 3-deck automobile carrier. In one trip 1,020 cars worth \$1,000,000 were carried. Commercial Barge Lines plans to resume this service after the war

arteries began to "harden." Packets were sunk and burned, railroads strode west at quickening pace, the pulse of waterway traffic slowed. By 1917 Old Man River could complain of almost total abandonment. Only a handful of showboats and excursion steamers and a trickle of barge lines remained.

Then Uncle Sam began taking an increasingly paternal interest in his ready-made water highways—partly for the sake of dependable internal freight channels, partly for flood control. The Ohio that would alternately spill over and run off too dry for shipping was reformed by dams into a series of 46 navigable pools stepping down 429 feet from Pittsburgh to Cairo. The Kanawha and other tributaries were similarly harnessed. U. S. Engineers ironed out the wrinkles of the lower Mississippi by a series of cutoffs that shortened the route by 150 miles, a day's travel by



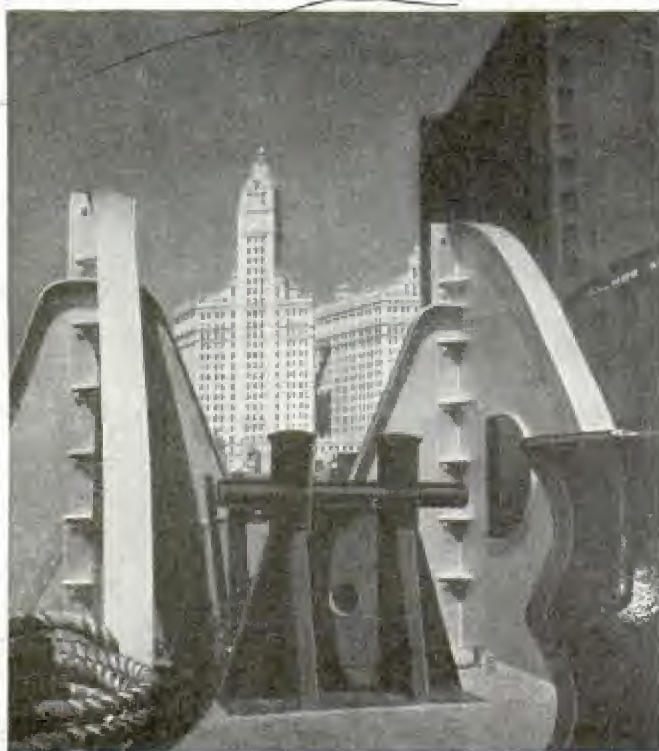
356 Wacker Dr
Chicago

Left, dropping the "lead line" to take soundings. Below, view from behind rubber-fendered towing knees of Pure Oil Co.'s "Anker L. Christy" in Chicago river

towboat—a \$295,000 powerhouse—not long ago shoved uphill to Pittsburgh a 3,200,000-gallon cargo of gasoline, equivalent to 320 railway tank cars.

A hundred years ago the rivers of the great central valley were the arteries of a young nation, pulsating with the floating "covered wagons" that brought life to the frontier. Fulton's Clermont was only four years old when the first Ohio River steamer, the New Orleans, was launched in 1811. But in those early decades traffic seldom moved upstream. Furs and cotton and other freight floated down on barges and rafts that were broken up for planking at New Orleans. Pilots steered them with poles.

With the Civil War, the river



barge. Channels were deepened, charted and lined with targets and buoys which are tended by the Coast Guard. There are over 2,600 lights and 5,000 buoys to be shifted with every shift of the capricious riverbed. Just now the TVA is finishing construction of a navigation channel in the Tennessee River which will make it a nine-foot deep waterway 650 miles from Paducah to the headwaters at Knoxville. Altogether the United States maintains around 16,000 miles of navigable waterways, 6,000 miles being deep channels from Minneapolis and Chicago and Pittsburgh to the Gulf and from the Texas sulphur and oil fields to Florida. Ice breakers can keep these main highways open throughout the year.

There are two missing links in the system which, when completed, would permit a tow of barges to circle the eastern states by way of the intracoastal Gulf canals, across Florida, up the Atlantic canal to Trenton and New York, by way of the New York canal system to the Great Lakes and Chicago, then down the Illinois and Mississippi to the starting point. These links are the cross-Florida canal recently authorized by Congress, and the Trenton-New York canal still under consideration. When these are open, no submarine can touch a tow of oil from Texas to New York.



Photo from Dravo Corporation

Building a mockup of the Kort nozzle for a river towboat. The nozzle increases push by controlling flow of water to screws



View of towboat above shows how Kort nozzle encircles propellers. Below, loading cars on a Commercial Barge Line 3-decker



Pittsburgh, Pa.
Draws Bldg.



On this board Union Barge Lines keeps track of its fleet of towboats, size of their loads, and barges awaiting pickup at various landings

The war has played unkind tricks on the barge lines. Formerly the bulk of the freight moved downstream—cotton, steel, grain from the upper Mississippi. Upstream movement was light. War reversed this. Traffic to the ports dwindled, particularly manufactured steel products and export grain. Sulphur and petroleum is moving north in tremendous quantities. Instead of 45 percent of the tonnage going north, now 85 percent or more travels against the current, only 15 percent goes south.

Barges and towboats are in great demand. There are about 500 companies operating 5,000 barges and 800 towboats on Mississippi valley waterways. The government itself operates—usually at a loss—the Federal Barge Lines, with about 25 towboats and 350 barges. Steel and coal and oil companies have their own barge systems. There are several big carriers, such as Union Barge Lines of Pittsburgh, which has a fleet of more than 120 barges with a capacity equal to 3,100 freight cars. Now that the east has developed its acute thirst for oil, many hopper and covered barges are being converted into tankers to float oil to Pittsburgh for transshipment by rail eastward. In addition some thousand tugs and towboats and barges are being built to haul 100,000 barrels of oil daily to the Atlantic seaboard.

Pilothouse of the "Anker L. Christy" retracts into deck to pass under bridges
Pure Oil Co. photo

Among the victims of this sudden conversion for war were the bulk of a small fleet of triple-decked automobile carriers whose brief day of bliss was interrupted by the demise of the automobile business. Commercial Barge Lines of Evansville, Ind., had started in 1935 to carry 24 automobiles on the roof of a loaded barge. Then superstructures were added, and finally outrigger wings, until the barge—on top of its normal cargo—could carry 190 automobiles. More barges were added, a towboat was built with a skyscraping pilot house whose floor was 24 feet above the water level so the skipper could see over his skyscraping load of cars, and in one trip the tow pushed 1,020 automobiles—a million dollar cargo—plus a loaded freight barge. The cars were loaded at Ohio river ports for Mississippi and Gulf ports and for Guntersville, Ala., southernmost port on the Tennessee. Most of those unique auto carriers are now oil tankers. Commercial Barge Lines has other work to do while awaiting the rebirth of the horseless buggy.

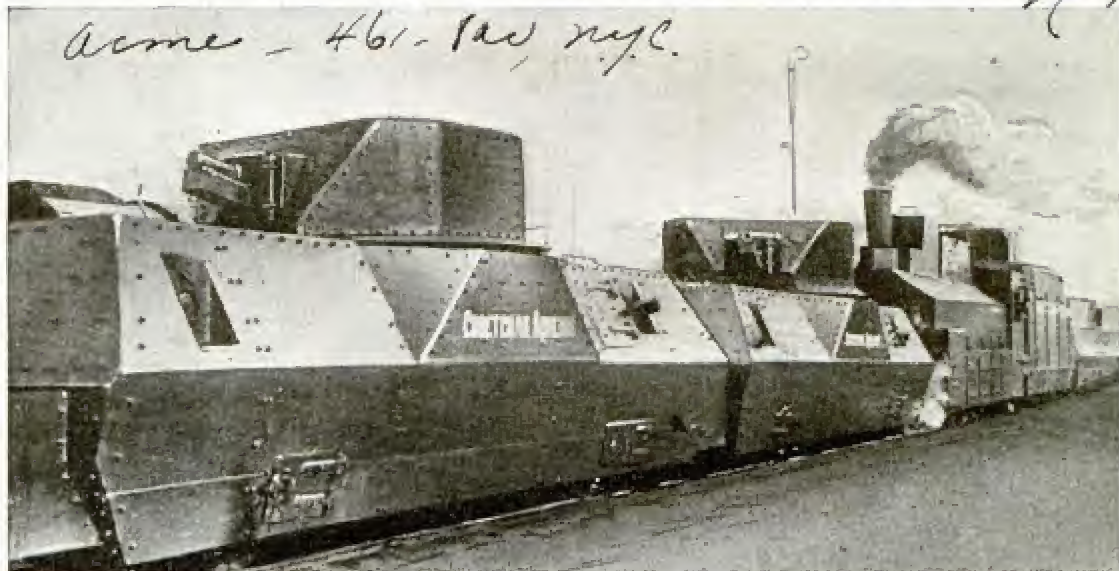
Chiefly it is the coal traffic that gives Pittsburgh its preeminence in waterborne tonnage. Coal comes down the Monongahela and Allegheny to feed Pittsburgh steel furnaces; the Monongahela has the densest river traffic in the world, floating 25,677,604

(Continued to page 152)



Soviet "Battleship of the Rails" Defies Enemy

77 115



Soviet land battleship, with cannon bristling in turrets of armored cars, has quarters for crew and gunners

Russia's contribution to armored warfare has included an impressive use of armored trains, angular, wheeled fortresses surmounted by gun turrets and sheathed in steel. Gun cars both precede and follow the locomotive, which is also steelclad,

even to protection for its driving mechanism. Self-contained, the armored train "Soviet Armenia," built with funds collected by the people of the Armenian Republic, is termed the nearest thing to a "land battleship" that exists.

Magnet Mounted on a 'Buggy' Recovers Industrial Scrap

Built from "odds and ends," a self-powered magnetic scrap picker constructed by the Timken Roller Bearing Company is

Canton Ohio



Magnetic scrap picker built from odds and ends does work of six men

doing the work of six men in gathering up scrap in the company's railroad yards. In two hours it does the work the six men required 24 hours to accomplish. Mounted on an ingot buggy, it is powered by a Hercules, Ford V-8 Diesel replacement engine that drives a 230-volt d.c. generator, which in turn supplies power for the magnet and the electric motor drive. The 39-inch magnet can lift 900 pounds of heavy scrap or 300 pounds of turnings per load, and travels on a 12-foot boom. The scrap is deposited in a box on the front of the picker that holds about 1,200 pounds.

After a million miles of service, inspection of the Union Pacific's streamliner "City of Los Angeles" revealed the crankpins had worn down only .001 inch.

Cont: Allen Warren Elliott, 7 Park Ave
N.Y.C.



Life raft is automatically ejected from top of fuselage and inflated with carbon dioxide as plane hits water. Below, it takes about 30 seconds to snuff out gasoline fire this way
Walter Kidde & Co. photos



GAS killed a lot of people in the last great war, but this time it is being used to save lives of fighting men in the air, on the sea, beneath the waves and on the land.

The gas which is playing the heroic role is carbon dioxide, which you exhale every time you breathe, which tickles your nose when you drink soda pop, which makes ginger ale fizz and makes bread rise. It is a by-product of fermentation. It is released from the air by combustion. It can be produced in your kitchen by dropping vinegar on baking soda. It is found in famous spring waters all over the world. It gushes out of dry wells. Most of the carbon dioxide used in the war is extracted from coke oven gases.

One reason it is so valuable to our war effort is that it can easily be compressed so that when released it expands 450 times its volume. This makes it useful to inflate

Walter Kidde & Co, Inc, West St,
Bloomfield, N.J.

Overloaded with 9 men, this raft—the kind that saved Eddie Rickenbacker—is still buoyant

life belts, life rafts, rubber boats, pontoons and flotation bags which will support men or airplanes in or on water. The pressure factor also has provided one of its newest uses and a foot-long steel jug of CO₂ can exert a kick up to 15,000 pounds when piped into a crippled hydraulic system on a plane. Among its regular pressure jobs is to open bomb doors and force down landing gears.

Since it is heavier than air and disperses quickly, it has another important wartime function, quenching of fire. The normal content of oxygen in the air is 21 percent. Gasoline, which makes an extremely hot fire, needs 16 percent oxygen to burn. The release of a small quantity of carbon dioxide under pressure quickly cuts the oxygen percentage down one third and the fire is smothered.

In solid form as "Dry Ice" it is doing the



same refrigerating job for our fighting forces it has been doing for the familiar ice cream vendor.

As a life saver, carbon dioxide has put forth its best efforts and most spectacular accomplishments in the inflating of life belts and "balloon boats." Thousands have been saved by the "Mae West" jacket types of life preservers, which serve as sweaters

Temporary ponton bridge of rubber rafts filled with carbon dioxide gas carries armored cars across a stream
U. S. Signal Corps photo





Waterwings filled with "soda pop" emerge from the wings as the plane strikes the sea and keep it from sinking. They are not used in war lest the floating plane fall into enemy hands

and can be inflated by pulling a cord, and the belt types which are usually inflated by squeezing two cigarlike cartridges containing CO_2 . Some of the latter type also have a hose, through which they can be reinflated by mouth. So compact and light

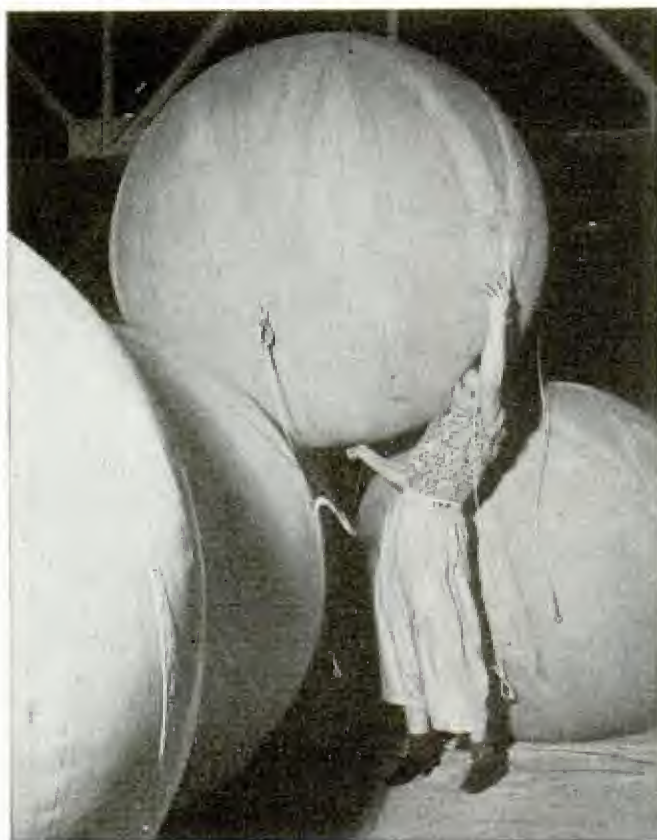
are these belts and vests that soldiers often wear them in jungles where they ford streams and cross swamps.

Tremendous strides have been taken in the development of rubber craft because of the efficiency of carbon dioxide. When a modern warplane crashes at sea, thanks to these mighty midget bottles of CO_2 , a door opens automatically and a rubber boat pops out already equipped and inflated. Water, entering the fuselage, touches off the mechanism. Or, when an aviator bales out over water, he carries a flat package about the dimensions of a brief case. The twist of a valve on the CO_2 cylinder in the parcel causes it to puff up into a rubber boat, ready for occupancy by the time his parachute has lowered him into the water.

Shipboard life rafts, assault boats, rescue rafts dropped from planes, even rubber barges used especially by the marines to haul equipment and supplies, employ the tiny portable powerhouses made possible by carbon dioxide. This gas serves for emergency inflation of huge pontoons supporting temporary bridges erected in a jiffy by U. S. Army Engineers.

Another novel use is inflation of

Spherical flotation bag used in an American bomber in case of crash landing at sea
OWI photo

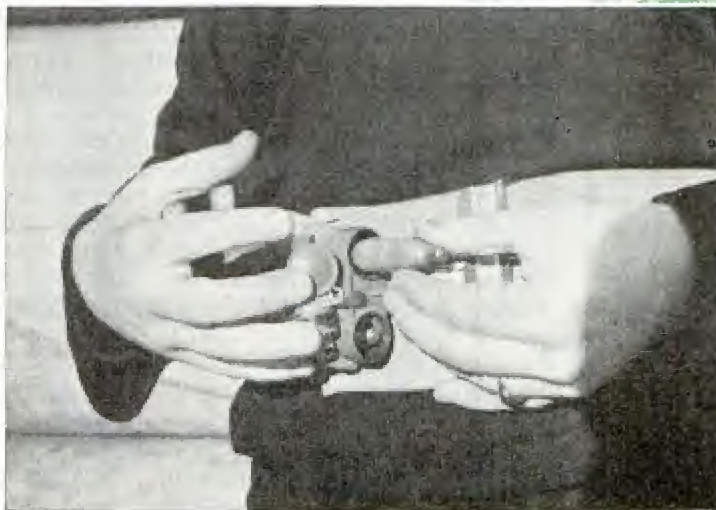
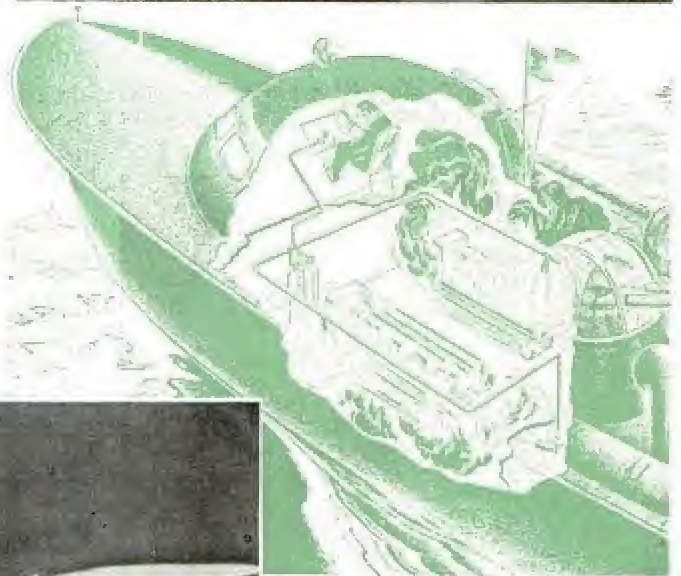


huge rubber tubes and balls which keep a land plane floating if forced down at sea. This feature was developed for army planes before the war, but was abandoned because it is better to let a fighting plane sink than to keep it floating for the enemy to pick up and examine for secret equipment. But it is widely used on cargo and ferry planes to keep them afloat long enough for the crews and passengers to escape with rubber boats and life preservers.

Its fire quenching value has saved lives in unexpected ways aboard warplanes. The obvious use is to put out flames, particularly around engines while flying in the air or while being serviced on the ground. But someone thought up a clever scheme after many planes were blown up when an incendiary bullet struck an empty gasoline tank. Because of the gas remaining, an empty tank is more likely to blow up than a full one. Gasoline burns quickly enough, but gasoline vapor mixed with air is as explosive as TNT, if not more so. The unknown hero who suggested that empty tanks be flooded with carbon dioxide kept a lot of 'em flying who would have been dead long ago.

Since airplanes are well sealed against drafts, when gasoline fumes accumulate they are literally huge bombs waiting for a spark or a blazing bullet to set them off. This inert, nontoxic soda pop gas is used to chase lurking gasoline fumes from pockets in which they wait for the touch-off.

Ships, particularly tankers, have



The raft at top, carried as a seat pack, is inflated with carbon dioxide as flier parachutes into sea

The sketch shows carbon dioxide piping arrangement used to fight fires on a U. S. Navy patrol boat

At left, inserting a new carbon dioxide cartridge into one of the Navy's self-inflating life belts
U. S. Navy photo

Int'l News. 326 W Madison, Chgo
Gunners Shoot Clay Birds From Plane Turrets

Sighting from a stationary fuselage with turrets equipped with shotguns, Army Air Forces aerial gunners pepper away at clay pigeons on a skeet-shooting range at a Florida field, to improve their aims for Zeros and Focke-Wulfs. Soldiers man the skeet traps behind a blind, and the clay birds zoom out at unpredictable angles, whereupon the gunnery students must swing their turrets to get a bead on the target.



'Welder's Window' Lets Him Look Into Glare

7-227
 Didymium, a rare metal, added to the standard welding glass, permits the gas welder to look through the blinding glare of his work and watch the operation from beginning to end, it was announced by Dr. E. D. Tillyer of the American Optical Company. He said the improved vision speeds welding production, and the glass protects the welder's eyes.



Soldiers above man skeet traps behind a blind, sending out clay birds at any angle as targets for air gunners in mockup of plane turrets, below

1 940 Thomas H. Southbridge, Mass.
Airsleighs Rush Men and Arms to Russian Front Line



Driven by an airplane-type propeller, airsleighs are used on snowy terrain

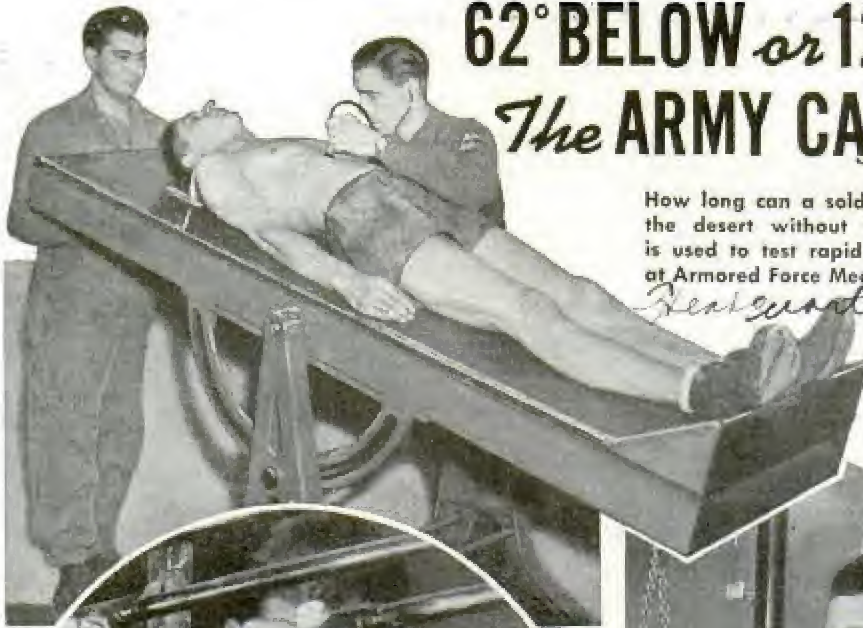
7-40
 Resembling a giant bread box on skis, the Red Army's airsleighs, which mount an airplane-type propeller at the rear, skim over the snow. They are used to take parties of automatic riflemen into action, or to bring up ammunition and supplies to the front lines.

Adhesive tape impregnated with sulfathiazole, powerful antiseptic which promotes healing of wounds without infection, has just reached the drug store counters.

62° BELOW or 120° ABOVE The ARMY CAN TAKE IT

M 1152
How long can a soldier stand at attention in the desert without fainting? This tilt-table is used to test rapid blood pressure changes at Armored Force Medical Research Laboratory

Heat chambers, Fort Knox, Ky.



Latest chemical and physiological equipment, besides two hot and cold test rooms, are used to check reactions of Armoreders. Gun fumes' effect on blood is studied above



Bearded soldier above is weighed in seat-scale to check for loss of weight after a fatiguing march around medical hot room



Effect of fumes within a tank compartment after a gun is fired is studied by pumping toluene down the barrel of "75," left. Movements of air through a tank are also charted



In temperatures as low as -62 , men, clothing and equipment are tested. Men and M-4 tank are in cold room



↑
Going nowhere the hard way, in a test of endurance, pack-carrying soldier in hot room "hikes" on and off platform



Both humidity and temperature may be altered to → simulate desert or jungle. In simultaneous experiment, one man rides stationary bicycle, others hike
Photos by Signal Section, Hq. Armored Force

The Lincoln Electric Co
Cleveland, Ohio

Foot Control for Arc Welder Straps on Like a Skate

729



Control strapped like skate to his foot allows welder to move

Increased speed and accuracy in arc welding are claimed for a foot control which is strapped onto a welder's foot and enables him to move about with it freely. Pressure on the skatelike pedal moves a protruding pin to operate the current control; the more the pressure, the more the current is increased. Especially intended for aircraft welding, the unit is suitable to the welding of any light-gauge sheet metal, makers assert, and its complete control of the arc is said to give improved quality to the weld, besides permitting the operator to stand in any comfortable position.

Baby Steel Mill to Make Alloy For Plane Factory Gauges

Faced with a dwindling supply of a special metal alloy used in gauges to measure by electrical resistance the heat in plane engines and wings, a thermometer maker called upon Westinghouse engineers for aid. Numerous alloy samples were tested to replace the metal, but results were unsatisfactory. Then metallurgists set about making the alloy, carefully measuring ingredients and cooking the mixture in a tiny electric furnace, which thus functioned as an undersized steel mill. Resistance tests of the product showed the need

for minute changes in the ingredients, but finally the proper alloy was developed and produced in 13-pound ingots, six of which would supply the thermometer maker for years to come and enable him to keep up with the Air Force's demands for plane thermometers.

Flame Detector for Tank Unaffected by Motor Heat

Fire detectors that automatically turn on an extinguisher when the temperature reaches a certain point are in common use, but a new protective device, especially for Army tanks, is activated instead by direct contact with flame. In tanks, overheating of the motor or a baking sun might set off an ordinary detector when there was no danger of fire. The basic element of the flame detector consists of two organic filaments holding open an electrical circuit. At the slightest contact with flames, these filaments are destroyed, the circuit is closed, and the extinguisher automatically is turned on. As an extra precaution there is also a fixed-temperature thermostat in the flame-detector, but this is set high enough so that it does not operate under the conditions of air or motor temperature in battle.



Heated motor or desert sun won't set off protector

Walter Riddle + Co Inc
POPULAR MECHANICS
West 21st, Bloomfield
72

"Kovar" developed by
Westinghouse Elec + Mfg Co
Pittsburgh, Pa

"Lincontrol" price \$25.00 with 20 ft of cable.

acme
461-8ad, nyc.

Sled Dogs Pull Snow-Troop Machine Gunners



Chinook kennels near
Wolancet, N. H.



Dogs haul gun-mounting sleighs to battle scene, but camouflage soldiers (above) handle equipment in attack

Trained to ignore smoke screens, whining bullets and the chatter of machine guns, teams of sled dogs are being readied along with Army snow troops in mountain maneuvers for battle in areas where drifts would bog down mechanized forces and hamper foot troops. Arctic huskies draw two-man sleds, each mounting a machine

gun, directly into the arena of battle. In the actual advance, the canine cavalry is disconnected from the sleds, and soldiers clad in the white of winter camouflage lay down their own smoke screen, then push their sleds through it against the enemy, blasting away with the machine guns as they go.

Wood Made Into Meat or Lard Feeds Hungry Europe

So stringent have food shortages in Nazi-robbed Europe become that reports from both France and Germany tell of artificial meat, sugar and lard made from wood and charcoal. In Germany, wood has been reported transformed into ersatz flakes of "meat," eaten either with a sauce or in soup. One German laboratory claims the ability to produce 30 to 40 kilograms of

sugar, suited for human consumption, from every 100 kilograms of wood shavings, and a Paris laboratory is said to have found a way to produce sugar from chestnuts. Other French scientists assert they can make even butter from charcoal.

☛ The new 45,000-ton battleship Iowa required 400,000 pounds of paint.

JUNE, 1943

Cliff Christian
Science Monitor

Cont: Thos. C. Stinson, Jr
3872 Franklin Ave
Los Angeles, Calif



Your own chickens can provide a steady supply of meat. Raise them in sanitary wire pens with individual cages

THERE'S plenty of food in this land of plenty, but you can't always have what you want.

Food rationing is here to make the coffee and canned goods go 'round. Butter arrives in fractional pounds, roast beef is as rare as a day in June and when you pay for some varieties of canned fish you wonder whether they're charging for a pearl.

Does it make sense?

271083
"In the last few years we have raised more food than ever before," says Dr. Joseph S. Davis, director of the Food Research Institute of Stanford University.

"At the same time, the men in our army are eating more than they did in civil life. Next, we are shipping tremendous quantities of food abroad to feed civil populations. This outward flow of food will increase with the growth of our merchant

fleet, though we can expect to receive more foreign commodities in return. Finally, higher wages caused more people to buy more food than they once did. Prices are up because farm labor, as well as labor along the line, is being paid more.

"What we actually have, instead of a food shortage, is a shortage in variety or selection. This may increase, and you can expect to carry more ration books before the war is over. The foods that are scarcest and highest in price are the ones most obviously due for rationing, which is here for the duration.

"Great Britain is on a wartime diet much more stringent than we are apt to experience. Yet no one there is suffering from mal-



These big plants are rooted in gravel flooded regularly with nutrient solution

see article April 1943
40

nutrition. We shall have plenty of nourishing food to eat."

Still, is there anything you can do about food rationing and the higher prices you are paying for food? There certainly is.

To begin with, don't hoard foods. The purpose of rationing is simply to make sure that you get your share without hoarding.

What you can do is to start raising some of your own food, even if you live in a city. That helps out in many ways. It slashes your grocery bill, provides you with the kinds of fruits and vegetables you like to eat, reduces the load on our transportation system, and allows more commercially grown food to be available for the army and lend-lease. The Victory garden program stresses three things: home production of fruits and vegetables, meats and meat products, and food preservation. By the latter is meant home canning and drying.

Millions of Americans pitched in and planted war gardens in 1917, then their enthusiasm diminished. Most of the gardens were dismal failures. The untrained amateur gardeners didn't learn their job, just as most of us have much to learn today. But tested information is available at little or no cost. The Department of Agriculture and

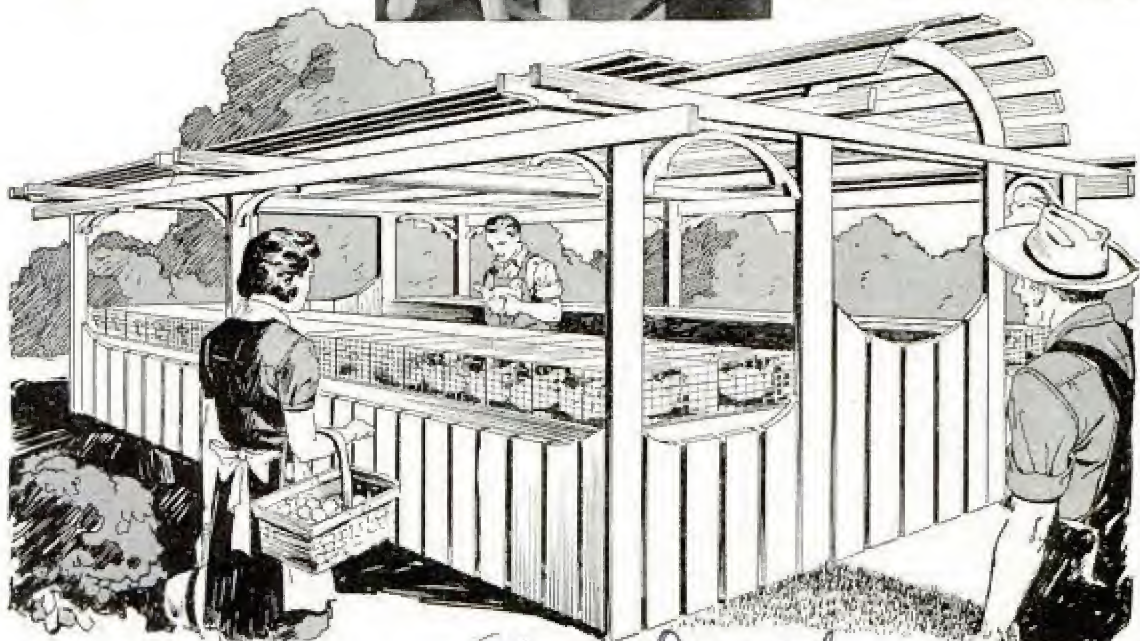


The vegetables above are being grown in controlled water baths to test the amount of minerals necessary for all-around growth



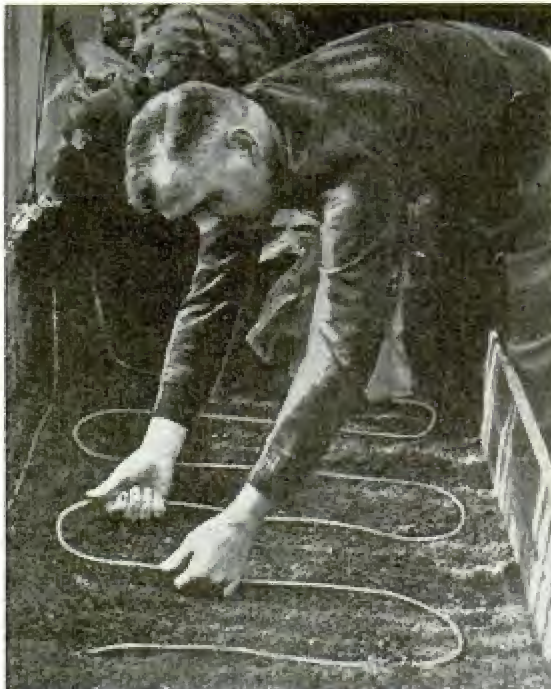
Left, measuring 26-inch leaves of a new rhubarb-like chard, an excellent source of minerals and vitamins, like most greens

The ornamental chicken house sketched below takes up little room in the back yard and is an efficient home meat factory



JUNE, 1943

Edw. Deethman
1312 Victory Blvd, Van Nuys, Calif. 67



Electrical heating wires buried in subsoil of vegetable bed force plant growth by keeping soil warm

commercially. Truck farmers will be asked to specialize on such crops as potatoes, cabbages, and onions. Unnecessary crops will be curtailed or abandoned, so if you feel that radishes or watermelons will increase your satisfaction, you'd better raise them yourself.

Some surprising facts about vegetable "efficiency" were discovered in a survey made by John H. MacGillivray, G. C. Hanna, and P. A. Minges of the University of California. They found that spinach is our most efficient crop. Mustard, kale, and similar greens are in the same category, if you don't care for spinach.

The survey measures the efficiency of 26 major vegetable crops on the basis of mineral and vitamin content, man-hours of labor required per acre, and the time it takes to grow a crop.

Radishes are the fastest crop to grow, since they are in the ground only 30 days.

But an acre of radishes yields less than 6,000 pounds of edible material and requires 273 man-hours of work. Irish potatoes, on the other hand, must stay in the ground four times as long but they are a much more desirable crop. They yield twice the edible weight of radishes at half the labor, and have a much greater nutritive value.

EFFICIENCY OF FOOD CROPS							
High Efficiency Crops				Low Efficiency Crops			
Crop	Days in ground	Food yield in lbs. per acre	Man-hrs. per acre	Crop	Days in ground	Food yield in lbs. per acre	Man-hrs. per acre
1. Spinach	50	9,618	117	1. Snap Beans	55	4,144	133
2. Carrots	80	17,496	243	2. Cantaloupe	160	5,868	195
3. Onions	110	18,650	239	3. Asparagus	365	3,330	188
4. Irish Potatoes	120	12,751	130	4. Radish	30	5,880	273
5. Celery	120	20,189	300	5. Cucumber	130	5,893	190
6. Winter Squash	180	12,580	58	6. Market Peas	70	1,107	143
7. Cabbage	90	9,987	111	7. Watermelons	150	4,783	110
8. Broccoli	150	3,450	176	8. Lima Beans	80	545	140
9. Cauliflower	75	6,180	151				

Vitamin and mineral content of crops, which helped determine their relative efficiency as foods, are not shown

Chart is based on tables prepared by Truck Crops Division, University of California

The chart above will help plan a garden according to time, labor and food value of the various crops. At right, setting a new type of mole and gopher trap

many of the universities have pamphlets that tell you what fruits and vegetables flourish in your community, when and how to prepare the soil and plant the seed, and what to do about cultivation and pest control. The University of California agricultural extension service, for instance, will send you information on spring and summer gardens, home canning, home rabbit production, and other subjects for a few cents per pamphlet. No matter whether you want to plant your entire back yard to vegetables or you merely try your hand at water culture in a few tanks near your apartment window, there's one important thing to remember—gardening requires more or less constant attention. It takes a little work at frequent intervals.

If the shortage of farm labor continues, the chances are that only vegetables that have high nutritional value will be grown



Spinach and similar greens head the list because they are in the ground only 50 days, require only 117 man-hours of labor per acre, and yield almost 10,000 pounds of food per acre. On an acre basis, spinach contains 221 pounds of protein, 7 pounds of calcium, a third of a pound of iron, more than a million calories, and high amounts of vitamins A, B₁, C, and G. Compared to spinach, sweet corn yields only 2,356 pounds of food per acre, 87 pounds of which are in the form of protein, a fifth of a pound in calcium, a hundredth of a pound in iron, about the same calories as spinach, and a much lower vitamin content. All these data are based on California conditions.

In their order of importance, the most efficient food-producing crops are given as spinach, carrots, onions, Irish potatoes, celery, winter squash, cabbage, broccoli, and cauliflower. Lima beans, watermelons, market peas, cucumbers and radishes are among the crops lowest in efficiency.

Raising chickens is frowned on in many cities and towns but some cities have recently rescinded their anti-chicken ordinances. It will be patriotic for other communities to do likewise. A backyard flock will keep you supplied with eggs and will provide meat at low cost. You can buy baby chicks for from 9 to 14 cents each and can use a large cardboard carton with an electric light inside as a brooder.

Up to fifty chicks makes a good start for a family of four. Ten percent are apt to die, and half the flock will be roosters. Begin eating the roosters at three months, just as they start to crow. The hens begin to lay at six months. A good common hen lays as many as 200 eggs a year. Sell your surplus eggs. Eat the poorest layers of the flock. Penned hens need commercial mash as well as table scraps and grain, and most hens eat a fifth of a pound of food a day. Counting the cost of feed, eggs from the flock will cost less than 15 cents a dozen.

Rabbits are another good source of meat. You can keep several pens in your yard.

In the last war the United States had to space out its wheat flour with substitutes. This time, we have plenty of wheat, and nearly all bakery products are enriched with vitamins and iron.

What about food in Germany? You'd be pretty unhappy if you had to eat German fare. Practically every food is rationed in small portions, in spite of the fact that Germany has commandeered food stocks from the rest of Europe to feed itself.

Here in the new world, such food worries don't exist. Eat the things that are abundant at the times that they are abundant, and forget about foods that are off the market or are too expensive. There is plenty of good food for all of us.

JUNE, 1943

Trueger Mfg. Corp
1469 Mase Mart
Chicago
Slip Cover on Ventilating Screen
Is Removable for Washing



Adjustable ventilating screens for windows are equipped with fabric covers that may be removed easily for washing. The pre-shrunk fabric fits snugly over a metal frame. The screen is 10 inches high and can be extended in width from 18 to 36 inches.

Gunner Changes Angle of Wing To Give Plane Burst of Speed

In evading pursuit, a plane using its rudder or elevator may "telegraph" its intended maneuver to an alert pursuit pilot, just as a boxer may telegraph his punch by drawing back before delivering it. To avoid tipping off the enemy pilot, and thus permitting him to change his own speed or course, Dornier, the German plane designer, has devised means whereby the rear-facing gunner in a two-man plane can change the angle of the wings, enabling the plane to put on a burst of speed to escape. Change of the wing angle is not so easily perceived by the attacking pilot, and with the German invention it may be done without the waste of time needed if the gunner had to give the pilot the proper instructions. Being an enemy invention, the Dornier patent is vested in the United States Alien Property Custodian.

* 2,308,796
Andirons made of refractory brick, and containing no war-vital materials, are now being used instead of iron.

Edwin Jackson Inc.
175 E 60 St, N.Y.C.

Claude
Friedrichs-
hafen
Germany

M 1040

Thos. C. Stinson, Jr. 3872 Franklin Ave., Los Angeles, Calif

OUR FIGHTING MECHANICS



Above, asbestos-gloved gunner on armored half-track scout car changes machine-gun barrel when it heats up. Left, courier has just delivered order to tank



TWO medium tanks are disabled ten miles east of here, sergeant. Take a couple of retrievers out there and bring them in. I'll give you a half-track for extra protection."

Five minutes later the sergeant was starting the two ponderous tank retrievers on their way. With them was the armored half-track scout car, virtually a mobile machine-gun nest with its gunners on guard against both air and ground attack.

Tanks are the mightiest vehicles of battle and yet the tank retriever is a mightier vehicle still. It has to be, for its job is to lift a disabled tank on board and carry it back to a repair base. Rolling on rubber tires so that it can make good time on ordinary roads, and sturdy enough to traverse rocky, broken ground, the tank retriever

is the ambulance of the armored ground forces. Such a vehicle may consist of a 15-ton, Diesel-powered, six-wheel, four-wheel-drive prime mover that tows a flat-bed 24-wheeled trailer on which a disabled tank is winched aboard. Some of the latest retrievers are even larger and have armored cabs.

If ground contours prevent the retriever from driving right up to a disabled tank, the retriever's hauling cable is let out until it can be attached to the tank, which is



then winched along until it can be pulled up onto the trailer. If the terrain is so bad that the retriever can't even approach the vicinity of the tank, a call goes out for the armored engineers. These engineers, among other things, are road builders. A giant bulldozer leads the way, followed by a mechanical scraper, and the way is smoothed right up to the disabled tank.

The mechanic is king in this mechanical war and he is also a fighting man. Repair and maintenance used to be a back-of-the-lines job but now groups of mechanics go right into the battle area to reach a tank in trouble or to take over equipment that has been captured from the enemy. If it is humanly possible they will make repairs on the spot, sometimes while under fire. Now and then they must drop their tools in a hurry and turn to their rifles and machine guns. Often the crew of the tank that they are repairing can back them up, using the tank's heavier cannon to beat off an attack.

If you were an ordnance mechanic you would find that working on a combat vehicle in the battle zone is vastly different from making repairs at leisure, back at the depot that may be 15

Tractor on opposite page is winching a 30-ton medium tank onto trailer of tank retriever, below, which has 3 rows of 8 wheels



Ordnance mechanics rehearsing desert fighting are primarily soldiers but spend most of the time repairing combat vehicles

Left, the battery commander of an antitank outfit is spotting the fall of shells through his sighting telescope on a tripod





Placing a dummy tank made of pipes and canvas on a jeep's chassis

or 50 miles in the rear. Back at the repair base are just the tools you need. Back at the base the dust is kept under some control. At the base, too, you can use shielded lights for working after dark. Out here in the field your tools are limited, the dust covers everything, and you work after dark without lights. You eat your dinner just as the sun goes down to avoid showing the light of a cooking fire after dark.

But in spite of these handicaps the chances are that you will do the job faster in the field than you would at the repair base. You repair the tank in record time because you must. Fixing that one combat machine in a hurry will damage the enemy more than anything you could do with a machine gun. Speed in getting equipment back into service is one of the things in which ordnance mechanics take pride.

One such emergency repair in the field may consist of yanking a whole engine, weighing several tons, out of a tank and replacing it with a new one. Maybe you must do it in the dark and maybe you have no tools but a set of socket and open end wrenches, a couple of punches and some hammers and chisels. In the meantime a dust storm is blowing up, another reason why you should hurry.

You get the job done with the aid of a big wrecker truck, using the

wrecker's rear winch and boom to lift out the old tank engine and swing the new one aboard. You are mighty fond of that big wrecker because it's helped you do the impossible a couple of times before. As far as you are concerned it's the best tool the Army has. It's a big job, weighs 15 tons, and has an oversized engine. It has a complete welding and cutting equipment, jacks, and wrecking tools on board. It's equipped with an overhead boom and front and rear winches that can operate independently and that can be triple-blocked for any kind of lifting or hauling. It has a system of deadman anchorages that give it the strength to pull a tooth out of the man

in the moon.

Even if you are working at a main repair base a good ways back of the lines you are still under battle conditions. Tarpaulins help keep the dust away while you are working on a tank transmission. A concrete floor is a rare luxury and your usual roof is a camouflage net, for the base itself is far from permanent. Everything is on wheels and the whole base can pick up and leave on short notice. One big overgrown truck contains a machine shop in its body. Another is devoted to tank maintenance, a third is equipped for small-arms repair. There is an electrical truck in which spare parts are carried and in which electrical repairs can be made; there are artillery trucks, and there are general tool and bench trucks for all-around repair work. On the road, this convoy of trucks keeps as close as it can to the combat machines. In



A 15-ton wrecker truck easily picks up the front end of an armored half-track scout car

the field, the units of the rolling machine shop disperse over a location as convenient as battle conditions warrant. Some of the Army's mobile machine shops consist of rebuilt railway cars and in some cases these cars are taken off their wheels and are towed out to field locations by tank retrievers and huge track-type tractors.

Ordnance mechanics are ingenious men and if they find that a new kind of tool would help them speed up tank repairs, they design and build such a tool themselves. They improvise special stands and jigs for working over engines and transmissions in the shops.

They may even rebuild some parts of the tanks between battles. That is, experience in combat may suggest certain improvements or additions to a tank, and often the mechanics can improvise the new parts in their shops and install them right on the spot. It sometimes happens that from three or four disabled tanks the mechanics can salvage enough parts to build up a whole new tank.

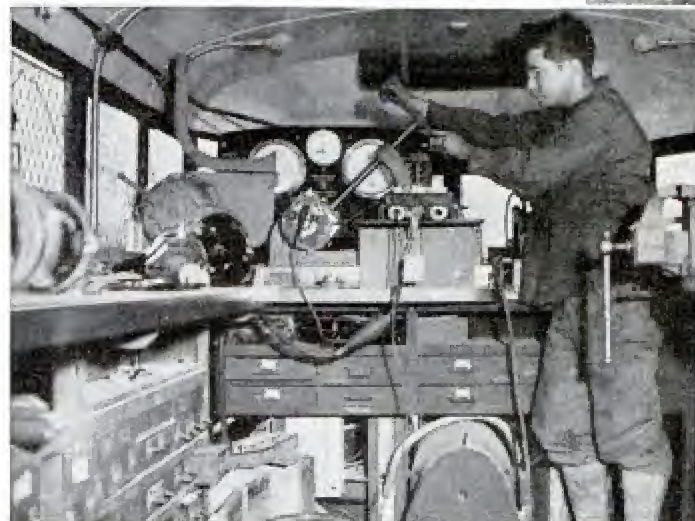
Not all their work is on real equipment. Dummies that appear to be tanks or other combat vehicles from the air are devices used by both sides in this war to fool the other side. A dummy tank may have painted canvas sides and top and its cannon may be a wooden pole but a company of them, moving slowly across the desert, can fool the enemy into a useless counter-attack. Dummy tank bodies are usually mounted on the light all-purpose jeeps.

When the Army began to expand its

Right, four-wheel-drive ordnance utility truck descends a steep desert hill, carrying ammunition to a tank rendezvous. Below, a mobile electric repair truck



Wearing goggles and dust mask, a motorcyclist armed with automatic rifle crosses desert ahead of tanks



mechanical side, the maintenance work fell to the ordnance department. This department took the job in its stride, though it already had the huge task of distributing all arms and ammunition. Whether it's a revolver or a 14-inch railway gun, the ordnance department issued it and can repair it.

Battle conditions are hard on vehicles and when you realize 56,000 combat vehicles were built in the United States last year you begin to appreciate the job ordnance mechanics are doing to keep them in service.

*Press Reel, Inc. 50 Rockefeller
Plaza, N.Y.C.*

Six-Motored French Air Giant Weighs 63 Tons

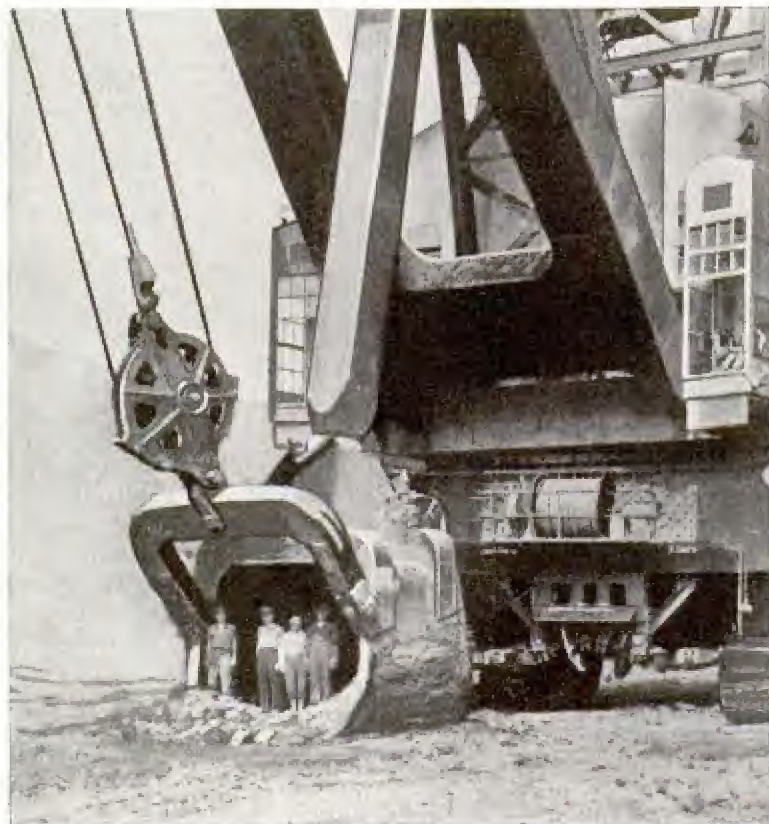


French flying boat, intended for the postwar ocean trade, was built to carry 40 passengers and eight crewmen

Intended for post-war transoceanic travel is the six-engined, 63-ton SE 200, completed at Marignanne, France, and now presumably in Nazi hands. Its motors develop 9,600 horsepower, and it carries a

crew of eight and 40 passengers, or 13,200 pounds of freight, with a claimed cruising range of 3,726 miles. Vichy dispatches say that an even larger flying boat weighing 70 tons has also been completed.

60-Ton Dipper Lifts Carload of Earth Every 50 Seconds



Freight-train load of parts was assembled into this record-sized shovel

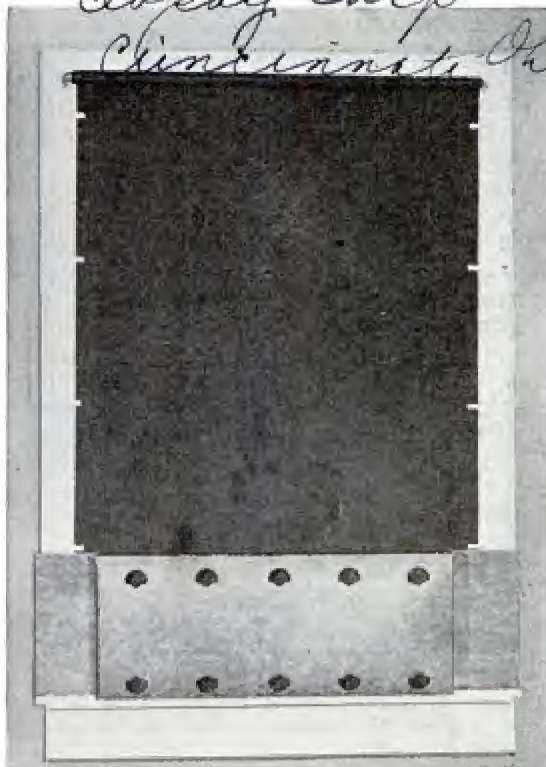
Matching in size any other shovel in the world is an electric shovel which strips nearly a million tons of earth a month from coal fields—enough to load a 70-car freight train in an hour. Its 60-ton dipper, as big as a garage, scoops up a freight-car load in 50 seconds' time. It is working 24 hours a day on an open pit, or strip, mine in Illinois, plowing away the dirt over veins of soft coal near the surface. When the ground is cleared to the coal level, special power shovels of a smaller type load the fuel onto waiting cars or trucks. A freight-train load of parts make up such a mammoth power shovel, which must be assembled at the site of operation. Featured in this one is a "knee-action" dipper stick, permitting the handling of additional weight, and

*Frank V. Faulhaber,
781 Woodward Ave
Brooklyn, N.Y.*
**Window Washer's Rail Cage
Climbs, Turns Corners** 78

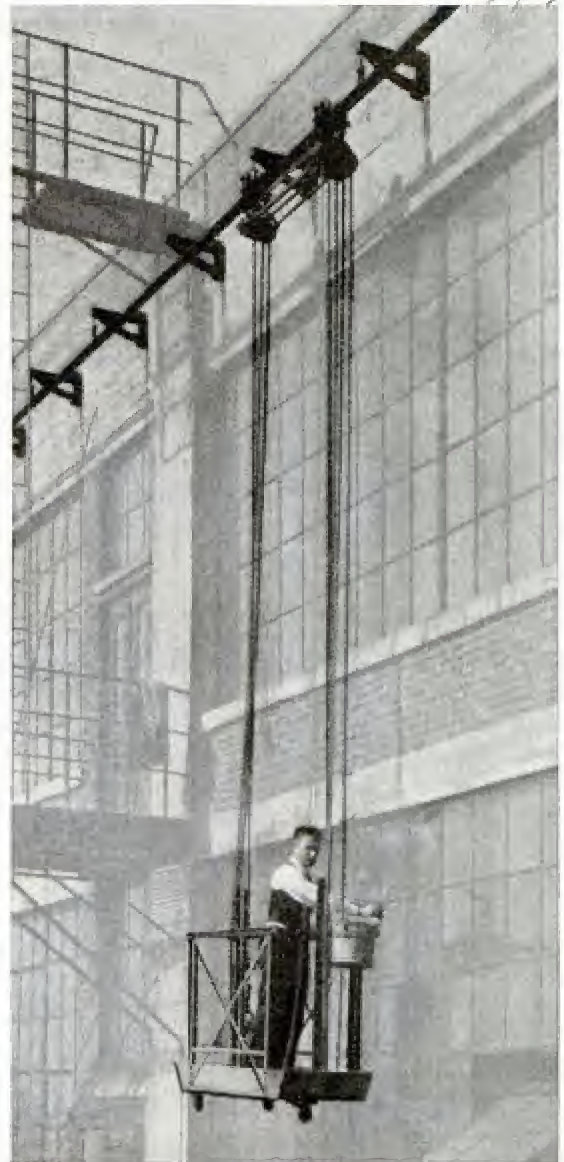
hydraulic jacks at each corner of the cab to keep the shovel level. Manufactured by the Marion Steam Shovel Co., the power shovel is equipped with General Electric amplidyne control, by means of which one man controls the shovel's three motions: swinging into position, "crowding," or moving the dipper into the earth, and hoisting the load. The control uses only one one-hundredth the current of conventional control. Resembling an electric motor or generator, the amplidyne generator is, in a sense, similar to amplifier tubes used in radios. Just as certain vacuum tubes, through the control of minute amounts of electric power, can control the flow of large amounts of power in other electric equipment, so the amplidyne generator can amplify hundreds or even thousands of times the variations in the power impressed upon it.

Blackout Shade Has Ventilator To Admit Outside Air

7/12/11
Fitted with a blackout ventilator, a special shade complies with blackout regulations or makes a handy lightproof seal for the photographer's darkroom. The fiber ventilator, which is weather-resistant, permits air to circulate but prevents light from showing through in either direction. Flexible clips hold the shade tightly against the window frame.



Ventilator at bottom excludes light, admits fresh air



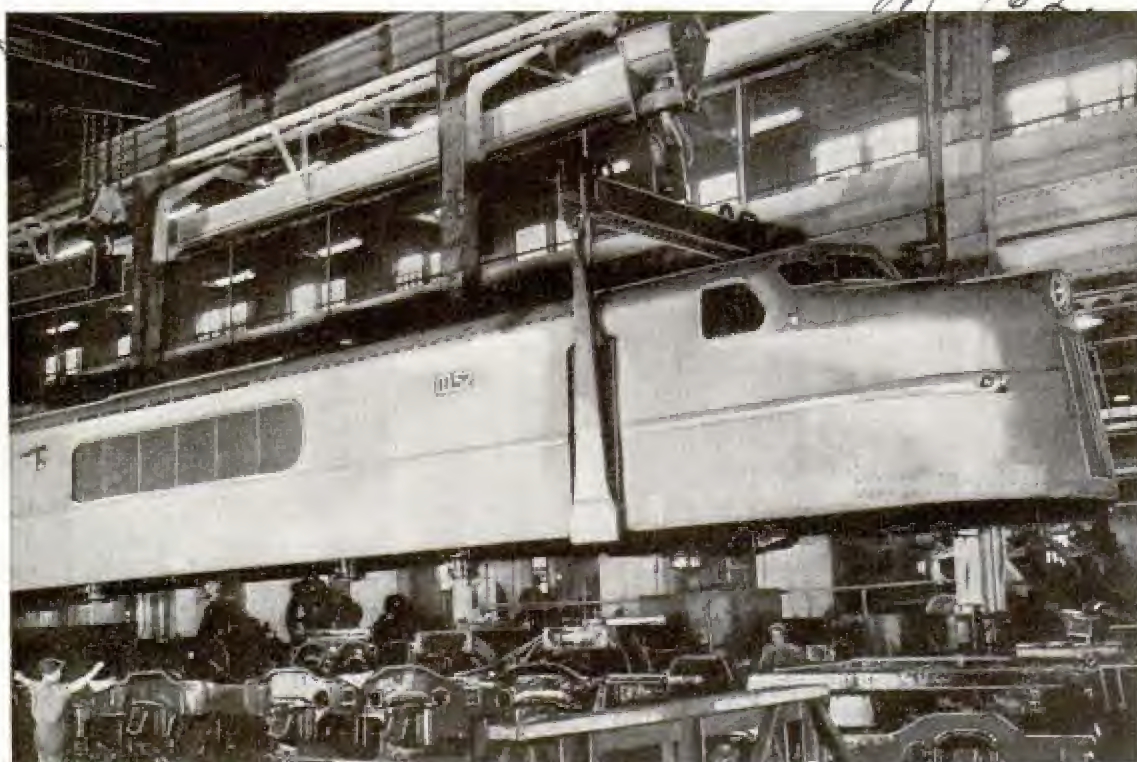
Cage's guard rails protect window washer from fall

Safety, speed and economy are claimed for a suspended cage for washing the outside of windows, which "rides" on a rail protruding from the wall near the roof. Its carrier may be propelled around the corners of the building, or raised or lowered by a chain hoist. It may be detached and rolled on casters into the building when not in use. Safety of the window washer—whose percentage of accidents is the highest per capita for all industry—is protected by the waist-high sides of the cage.

Write to the firms listed in the Where-to-Buy-It index, to learn more about products described in this magazine. Say You Saw It in Popular Mechanics.

MAN'S ARMS and LEGS of STEEL

Westinghouse Elec & Mfg Co
Pittsburgh, Pa.



Cranes lower 142-ton locomotive to its chassis. Below, 40-foot telescopic platform extends man's reach

Lewis - Shepard Sales Co
245 Walnut St. Watertown Mass



IT WAS something of a handicap for man to be born with a puny set of muscles and a three-foot stride.

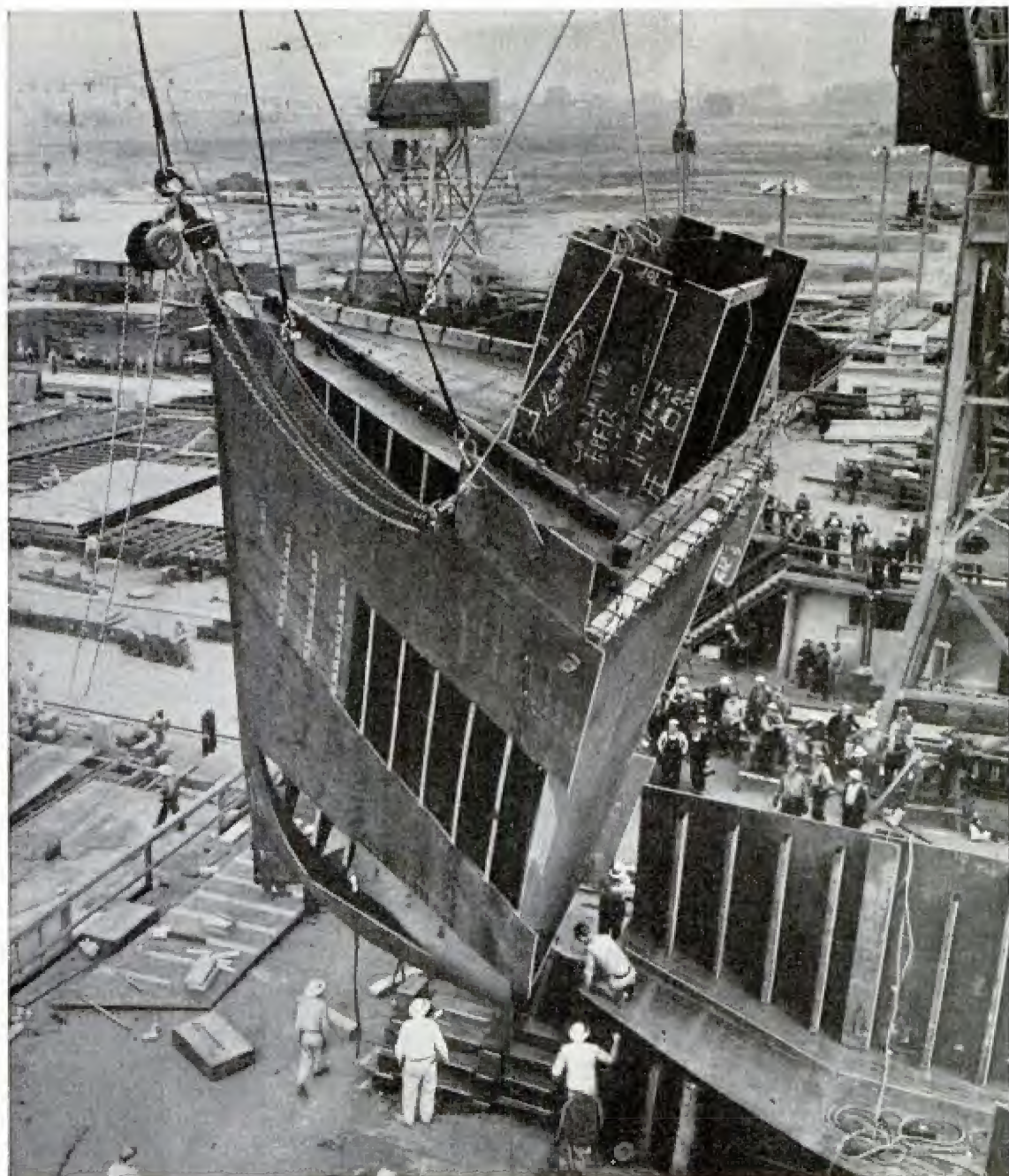
When you visit one of those sprawling new factories where production lines and conveyor systems are measured in miles you realize that. When you see overhead monorails that resemble a maze of freight-yard tracks and watch little trucks pick up a handful of eight-foot tires weighing more than your winter's supply of coal, you reflect that man could do nicely with a set of built-in seven-league boots and biceps capable of a ten-ton lift.

The railroads are legitimately proud of the astronomical tonnage they are hauling. But little has been said of the stupendous moving job industry is doing for itself, right inside its walls.

Production, of course, is the main thing. But next in importance to production and a prime factor in it is the moving of materials and products.

In fact, a General Electric company executive says that 90 percent of the effort in manufacturing is moving things. Man may be a physical weakling, but he has built himself iron muscles and lungs and legs of tremendous power and efficiency. Take a look at some of them.

In the vast aircraft plants, distances are so great that both men and machines must



Powerful cranes hoist the prefabricated steel prow of a Liberty ship into its place on the keel

have well-organized traffic systems to prevent a slowdown of output. You can stand at "27th street and Avenue D" in the Douglas factory and watch a pint-size locomotive tow a special train of dollies loaded with engines and propellers and aircraft parts to their places on the assembly lines. A mile-long conveyor carries Airacobra parts through the Bell Aircraft plant; girls hang small parts on "Christmas tree" racks which ride a conveyor that dips them into paint baths, carries them past batteries of infrared lamps and delivers them dry. Bombers grow wings and fuselage and

controls as they are dragged by a chain conveyor between rows of bins in a North American Aviation plant, and they are finished when they reach the American flag that marks the beginning of the flight-test ramp. Flying Fortresses without wings ride across Boeing's ceiling on powerful monorail cranes, and between two widely separated Curtiss factories in one city tractor-trailer units carry four completed P-40 fighter fuselages on a 24-hour schedule. Bomber engines roll on a mezzanine conveyor at the Ford Willow Run works to rendezvous with center wing sections mov-

*Galley
try*

205 Elmwood Av
Buffalo, N. Y.



man" lifts the bridge. Giant cranes with the strength of more than 3,000 men gently lower the 142-ton cab of an 80-foot electric locomotive upon its chassis.

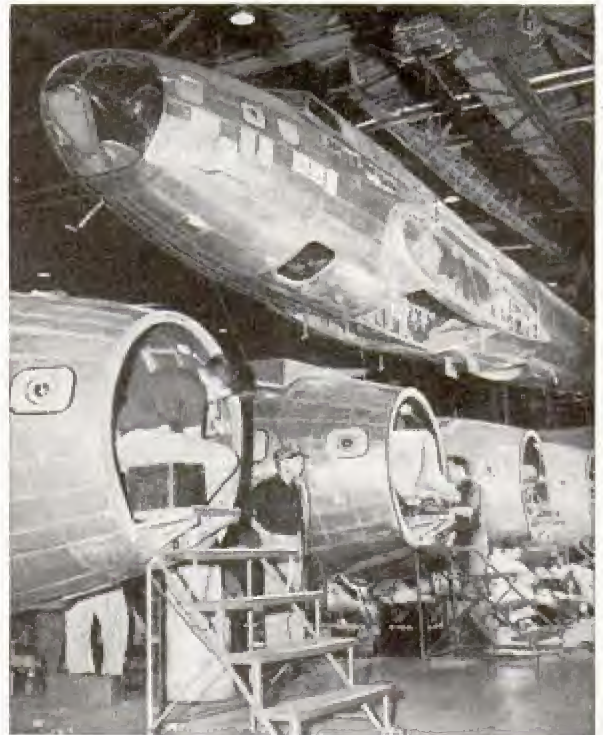
General Electric, in keeping with its name, has endeavored to translate muscles into pushbuttons in every possible job of handling. In one big plant an overhead conveyor system was installed to carry materials from 36 dispatch stations to 49 receiving stations throughout a 15-story

Conveyor (left) at Bell Aircraft factory dips parts in paint, parades them past infrared lamps, then delivers them dry. Below, fuselage of a Flying Fortress rides monorail crane over Boeing assembly line

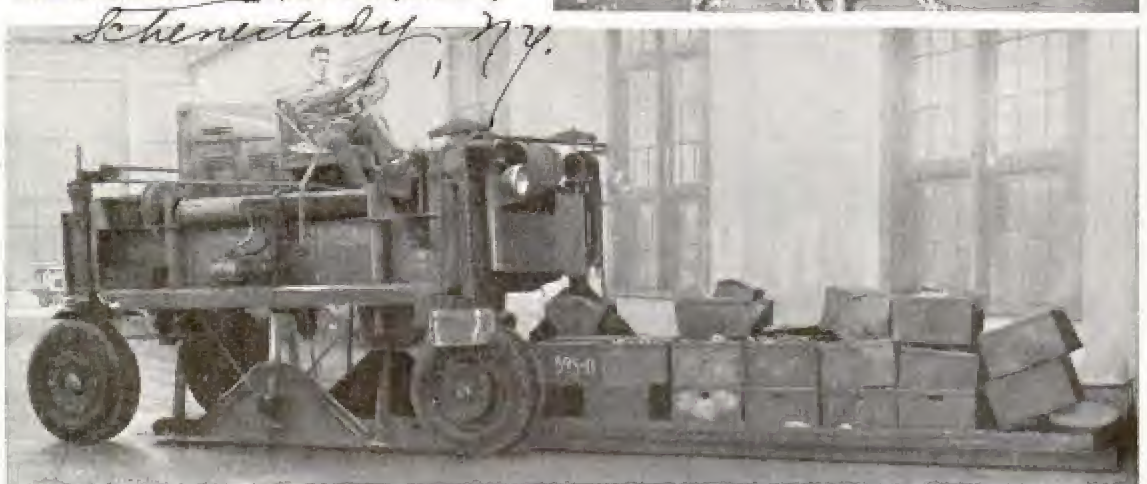
ing parallel on a ground floor conveyor.

Within a Western Electric Company plant is a seven-mile freight line they call the "busiest little railroad in the world," carrying mile for mile a heavier load than any trunk line railway in America. It brings in raw materials, transfers materials between buildings and starts finished products on their way from the 120-acre factory. The Caterpillar Tractor Company, too, has its private railway with a tunnel through which Diesel tractor locomotives haul goods between yard and shop.

Traffic is big business at the Westinghouse works in East Pittsburgh, which has an electric railroad and a 5-mile roller conveyor system. An industrial truck carrying control apparatus for a submarine halts at a drawbridge blocking the aisle until the stream of half-assembled motors crossing the conveyor on the bridge halts and the "tower-

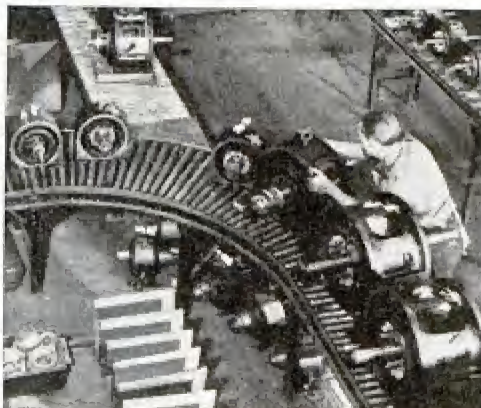


Straddle truck drives over a scrap-loaded platform at General Electric plant and picks it up



building. It's entirely automatic. The load is placed in a carrier, the operator dials the delivery point, and the conveyor picks up the load, routes it to the proper point, unloads it automatically, clears the tabs set by the dial, and deposits the carrier by gravity at a convenient level. Traffic jams are impossible, trucks and packing cases in the aisles are eliminated.

Pushbuttons control the delicate task of pouring molten iron from a 500-pound ladle suspended from a monorail. "GE" has specialized handling machinery for every duty. Little fork trucks carrying 1,000 pounds to 8 tons lift their loads 9 feet high, tilt to load or unload, scoot around inside freight cars and in narrow aisles. A huge yard truck straddles its cargo and picks up skids loaded with 14,000 pounds



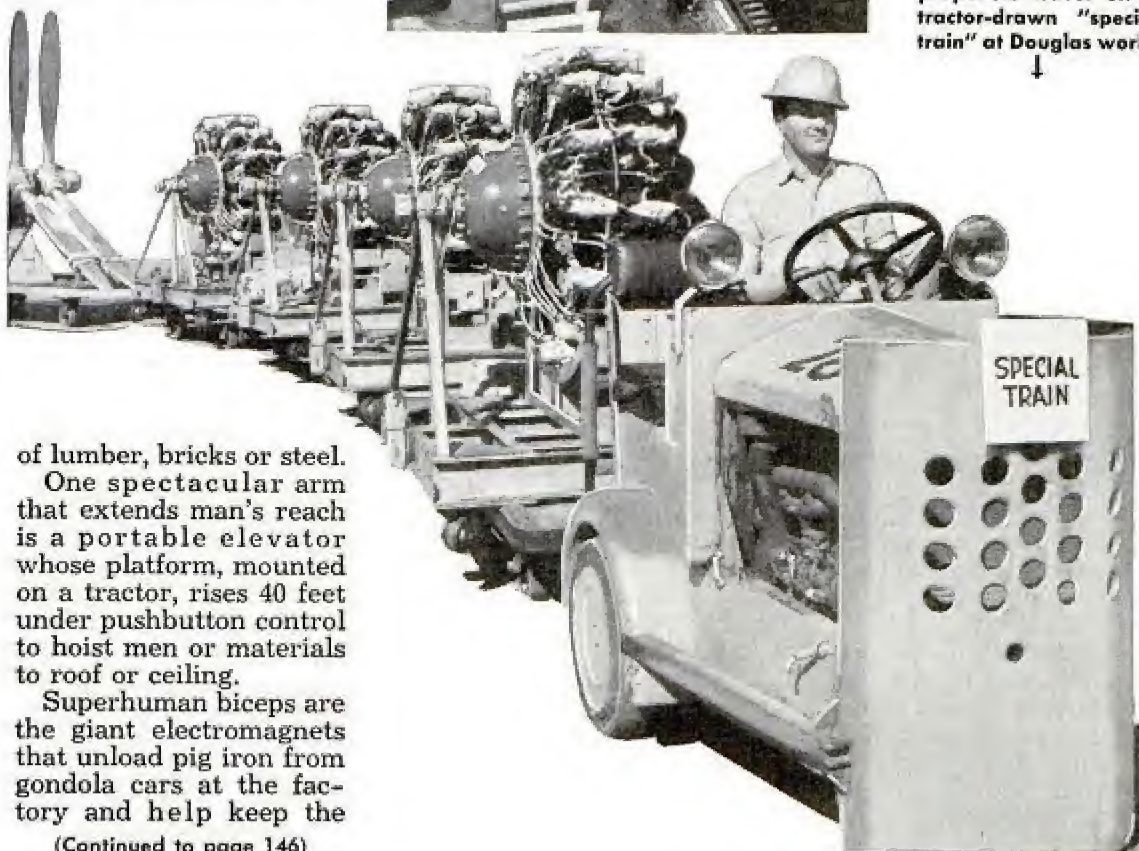
↑
It would take many human biceps to lift giant tire held at arm's length by a Towmotor Truck

← Over five miles of roller conveyors form an assembly line for motors at a Westinghouse plant

↓
Airplane engines and propellers travel on a tractor-drawn "special train" at Douglas works

1226 E. 152 St
Cleveland, Ohio

E. P. G. Pa.



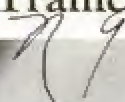
of lumber, bricks or steel.

One spectacular arm that extends man's reach is a portable elevator whose platform, mounted on a tractor, rises 40 feet under pushbutton control to hoist men or materials to roof or ceiling.

Superhuman biceps are the giant electromagnets that unload pig iron from gondola cars at the factory and help keep the

(Continued to page 146)

Light Gun Beams Three Colors To Direct Warplane Traffic



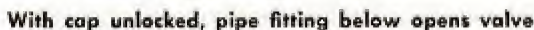
When radios at advanced United Nations airports are silenced to prevent information from reaching the enemy, a multi-colored signal light of 500,000 candlepower may be used to convey information to friendly planes overhead. Portable and operated by a trigger control, the airport light can send a beam of white light a mile into the air. A pull of the trigger changes the beam to red, and another flick changes its color to green.

Principles on which wartime submarine

in cases of intoxication. Two University of
 80 by Dr. R. F. Smith and
 Dr. E. G. Bevere

Lock Cap on Water Outlet Guards Hidden Valve

7658 Columbus Ave
Chicago



Major J. P. Leggett, 2200 7th Ave
Dayton Ohio

Troop Planes Converted Into Flying Ambulances

795



Metal arms and clamps on side of flying ambulance hold tiers of litters in place, also facilitating medical care while flying to hospital, as at left

→ Pvt John Lupso

Stretcher-carrying jeeps also pull trailers bearing wounded to ambulance planes (below). Speed in getting men to hospitals may mean saving a life



Five minutes saved in speeding wounded men to a hospital may mean the saving of a life; five hours may save a dozen lives. Ambulances on wings, converted troop transports, stand by near every battlefield where Americans fight, ready to speed casualties back to base hospitals. Capacity of these air-borne couriers of mercy is multiplied by arranging stretchers in tiers. Metal arms and clamps to hold the litters in place make possible the transformation of a troop carrier into an ambulance plane. Besides the pilot and co-pilot, the planes carry a medical technician to pinch-hit for the doctor and a nurse. At an air field in Kentucky, crews practice the routine of lifting wounded men in and out of the big transports, striving for speed, smoothness to protect the injured, and efficiency that will so familiarize them with the plane's fittings that they can work in the dark. Classes include doctors studying high altitude medicine, nurses, and medical technicians. Routine for an injured soldier includes first aid on the battlefield—a hypodermic shot, a tour-

niquet or a dressing. Next a doctor, after attending him, gathers other wounded at a sheltered spot where the flying ambulance lands to pick them up.

¶Forty-two states and the District of Columbia are using last year's auto license plates by changing the year date to 1943.

Lt. Catherine Hogan

Woman Field

Thos C. Stinson, Jr. 3872 Franklin Av
Los Angeles, Calif

AMERICA'S DESERT LEGION



A tank's big gun speaks and streams of tracer bullets issue from machine guns. Below, releasing a carrier pigeon



WHAT'S it like to ride inside a 30-ton tank, buttoned up for battle?

It's like riding in a heavy airplane that is taxiing across a rough field. You are too busy to hold on and you are going to depend on your safety belt to hold you in the seat and on your crash helmet to protect your head when it slams against the steel gun mount above your ear.

In front, the tank driver is wrestling with a lever to change gears as he peers out through his battle slot. Beside him one of the gunners is maneuvering his hand wheels, training his cannon on a target up ahead.

It's a lot hotter than you thought it would be, and it's dusty. Even with all the ports closed down the dust filters in and bites at your eyes. But mainly you notice the noise. The crew must wear earphones and throat mikes for communication. The hammering engine is so loud that you don't even hear the firing of the heavy cannon beside you, though you see the breech shoot back in recoil and can smell the cordite fumes.

What the gunner had aimed at was not an enemy tank this time. His target was a junked automobile hidden in the brush. For instead of being in Libya you are on the 30,000 square mile "campus" of the Army's desert training center in the southwestern part of the United States. Here, under Major General Walton H. Walker, our armored ground forces get their final

battle training before going abroad.

This training area, almost four times the size of Massachusetts, is one of the most desolate regions in the world. It is a land of blistering heat, extinct volcanic cones, jagged mountains, and dusty dry lakes. Water holes are scores of miles apart. Some early travelers, a few surveying parties, and a prospector or two are the only ones who have set foot in some of its reaches.

These factors make the desert an ideal training ground. The climate is typical of all desert regions, and the terrain includes geographical features such as might be found in many parts of the world. The area is so vast that whole campaigns can be laid out and rehearsed in full scale. Problems of supply are identical with those in a big campaign. It is so remote that new weapons can be studied and new tactics can be tried out in complete secrecy.

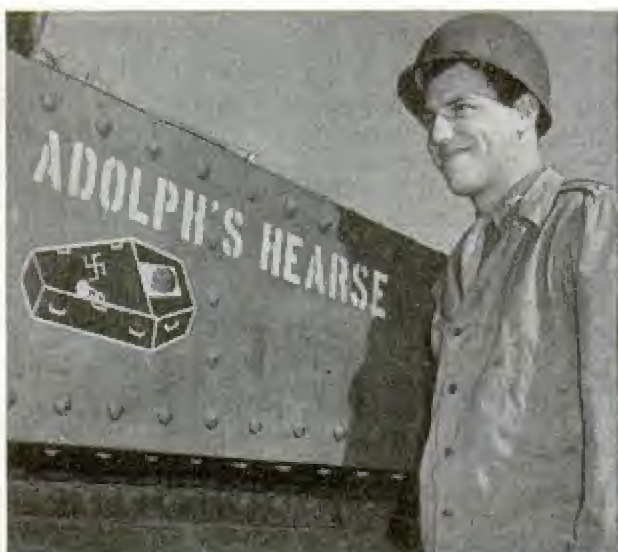
Today a band of big-horn sheep in a rocky valley may be scrambling away as a party of paratroopers drift down from the sky. Tonight a lonely coyote may be disturbed by the shrieking of battle sirens and the roar of engines as a dozen or a hundred tanks charge without lights across the desert wastes.

Just as in a great battle, you can see only fragmentary parts of the fight when a full-scale maneuver is being conducted. A machine gun crew or some antitank gunners may be digging in under some desert brush. A slow "grasshopper" observation plane drones by overhead, or with no warning but their sudden roar a squadron of dive-



Every member of a desert raiding party must be skilled in disarming his enemy. Above, a Yankee shows how to defend himself against an antagonist's knife. Below, a captain creeps up on enemy outpost, keeping covered





Approaching silently, raider chokes an enemy sentry, above. At upper right, crews of armored vehicles bestow pet nicknames on their tanks

bombers, hugging the ground, snarls over and out of sight.

Dust haze in a distant valley marks a major advance of tanks. Hidden in a box canyon you may find a camouflaged half-track armored scout car, capable of traveling almost anywhere. Its crew is living on the "enemy," raiding the other side for fuel and food, attacking command posts, and sending information back to headquarters by carrier pigeon to preserve radio silence. They are a red-faced and dusty bunch of tough desert fighters, each



Knife-throwing (above) is a quiet way of disposing of a sentry. At left, shooting the sun with sextant from a scout car. Celestial navigation is used on wide-scale maneuvers

man armed to the teeth. Distances are hard to judge in the clear desert air and it's easy to get lost, so the raiders use dead reckoning and celestial navigation as well as their maps. Before the maneuvers are over you will probably get a glimpse of General Walker riding in the turret of his tank "Warrior" or hanging on to the side of his armored scout car "War-Whoop" as it climbs over a rise. In desert warfare, generals as well as privates sleep and work in the field.



Clever defensive tactics have downed the man with knife. Right, tank's machine gun in action on the ground

Maneuvers such as these are the final part of training. Few men would be fit to participate while still new to the desert. Even though the soldiers have been toughened by months of Army life they must still be adjusted to the climate. In the summer the heat ranges up to 130 degrees and it's sometimes hotter than that inside the tanks. Nights are cool and the temperature goes down to freezing in the winter.

During the first ten days that they are stationed on the desert, if the weather is hot, the men do practically nothing. For a while they have a siesta from 10 to 3 every

day. A maximum of only 15 minutes is permitted for sun bathing and the men must keep their heads covered at all times in the sun. Salt tablets, the right kinds of food, and a gradual program of hikes and exercises bring them up into condition. Oddly, under these circumstances the desert is an exceptionally healthy place. The arid climate prevents most colds and respiratory diseases. The wooden office buildings at the camp headquarters have double roofs to repel the heat. Some of them are equipped with evaporative air coolers. Everyone sleeps in tents.

A light tank charges up a rocky embankment on the southwestern desert during war games, with turret open





This desert Commando shows how to put an enemy sentry out of the fight with his knife. At right, one of the desert raiders drains the last drop of water

The desert training center is a proving ground for materiel as well as for men. A special desert warfare board is in charge of testing all types of equipment. Guns, tanks, trucks, food, clothing, photographic equipment, even mobile paymaster's offices must all pass field tests before being judged fit for battle service. Radio sets, for instance, must be able to operate reliably after a

The vivid night photograph below shows streams of tracer bullets bouncing off armor of a 30-ton tank

dust storm so intense that it levels a whole camp of pup tents. Dust protection for motorized equipment is a special study.

The value of such a testing program has been well proved. Early in the war a British tank brigade, using American equipment, fought an amazing campaign in north Africa. Until then no one had been able to operate tanks for more than 10 days in a row. The ponderous vehicles had too



many weak points. But during this offensive the American tanks were driven through 32 days of continuous service and combat. Only 12 minor mechanical failures occurred among the 90 tanks that participated, though one tank traveled 900 miles. One squadron received an average of five direct hits per tank, yet only two of them were stopped.

Exhaustion of the men, rather than mechanical limitations, was the limiting factor. Toward the end of the month of constant operations the men were so worn out that they fell asleep at each stop. They existed on hot liquids alone. As for the tanks themselves, it was only necessary to replenish fuel, water, and oil to keep them going. Sometimes these necessities were delivered by air.

Victory in mechanized warfare goes to the side that is best trained, has the best leaders, and the best equipment. That's the reason for the emphasis on letter-perfect training on the desert. Instead of merely training our armored warriors to be fit for battle, America trains them to be fit for victory.

First New Grain in Eons Is Wheat-Rye Hybrid

For the first time in at least 3,000 years an entirely new type of grain has been developed, through a process that speeds up evolution by centuries. It is a wheat-rye hybrid, said to give outstanding promise of feeding a hungry, post-war world. Hybrid plants are usually sterile, and the new grain is given fertility by, first, a bath of coconut oil which encourages the tiny embryos to grow into large, though sterile, hybrid plants, and next by treatment with the drug colchicine, which makes them capable of reproducing. Colchicine itself is an old gout medicine, and has been found by American scientists capable of doubling the rate of growth of certain trees. The new grain, said to equal wheat in yield and palatability and rye in hardness, was developed by Swedish researchers and has been grown in Russia. Its many experimental types all produce good baking flour. All other grains antedate history.

JUNE, 1943

Int'l. 326W modern, Chicago Hidden Plant Has Tiny Train To Carry Aircraft Parts



Tour of underground British plane plant is made on midget train

"No passengers" reads the warning on a midget electric train, used for speedy transportation of materials throughout the sprawling, underground plant of one of Britain's airplane manufacturers. But the edict was waived recently when a group of visiting American plane production experts, touring the plant, rode the train to inspect work in progress.

Pistol-Grip Spotlight Hangs on Dash

Police officers spot their "targets" readily with a mobile spotlight, which may be removed from the dashboard of the prowling car and aimed in any direction. It has a pistol grip, and a trigger-type switch.



Police spotlight unhooks from dashboard and aims like a pistol

Inf: J. N. Thompson, C-87
Dayton, Ohio

reported by Dr. C. H. Darlington, London geneticist

Kimberly - Clark Corp *Neenah, Wis* **Roll-Up Insulating Blanket** **Also Blacks Out Windows**



Insulating blackout-blanket rolls up when not in use

To prevent the leakage of air around windows, an insulating material is supplied in the form of a blanket that can be cut to the desired size. When not in use, the insulating blanket may be rolled up to the top of the window. Besides providing blackout protection, such insulating blankets could also be used to block off unheated rooms.

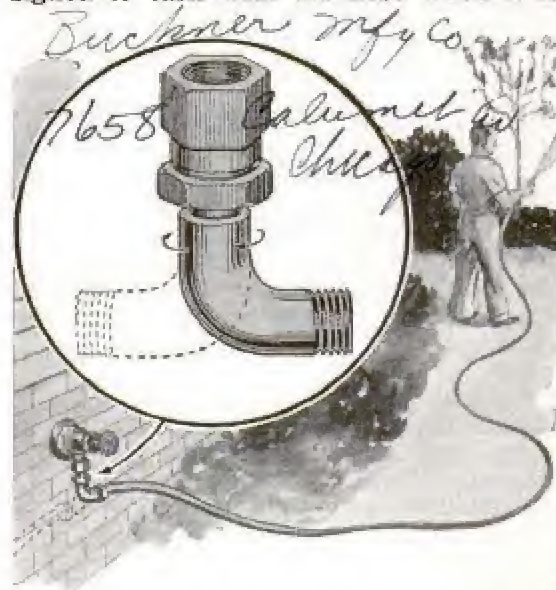
Weighing Battleships and Germs Is Tough Even for Scientists

Measuring an object as big as a battleship or as tiny as an electron is subject to far greater error than in estimating the length or weight of a "medium-sized" object, such as a standard meter bar or a kilogram weight, according to Dr. Harvey L. Curtis of the National Bureau of Standards. A battleship is about the biggest object man can weigh directly, but the 52,000-ton dreadnaughts of the Iowa class might actually weigh as much as 52,052 tons or only 51,948 tons without anyone's knowing the difference, for a battleship cannot be weighed with accuracy closer than one part in 1,000. By contrast, a kilogram weight can be compared with another with an accuracy of about one part in a billion.

At the lower end of the scale is the pneumococcus germ or virus—it would take 1,000,000,000,000,000,000,000,000,000 (one octillion) of them to equal the weight of the biggest animal, the blue whale—yet the electron is far smaller. The mass of the electron has been determined within an error of one part in 100, compared with one in a billion in comparing kilogram weights. Similarly, accuracy of comparisons falls off with either increase or decrease in lengths being compared. A 1,000-meter standard base line's accuracy can be determined only to one part in a million, compared with one in ten million for a single meter. Diameter of a proton, smallest known object, has not been determined within an error of less than one part in ten.

Swivel Elbow for Hose Faucet Saves Kinking the Rubber

Now that garden hose has become difficult to replace, owners are taking every precaution against its damage. One source of trouble—kinking of the hose at the faucet—can be remedied with a swivel elbow that screws into the water outlet. Designed to turn with the hose when it is



moved around while watering the lawn, the elbow takes up any tendency of kinking. The brass swivel mounting, packed to prevent water leakage, operates with a moderate tug.

Names and addresses of makers or sellers of commercial products described in this magazine are listed in the Where-to-Buy-It index. Write to them for additional information and be sure to Say You Saw It in Popular Mechanics.



The CRAFTSMAN

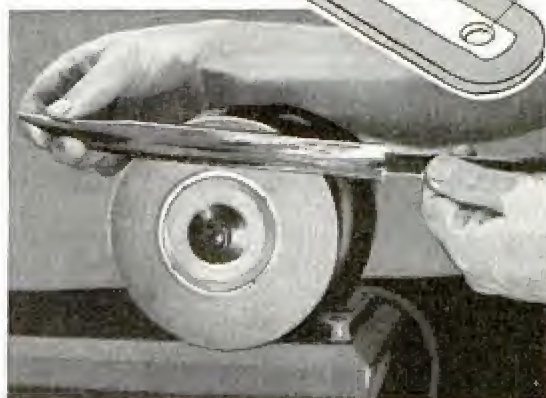
High-grade CUTLERY from hacksaw blades



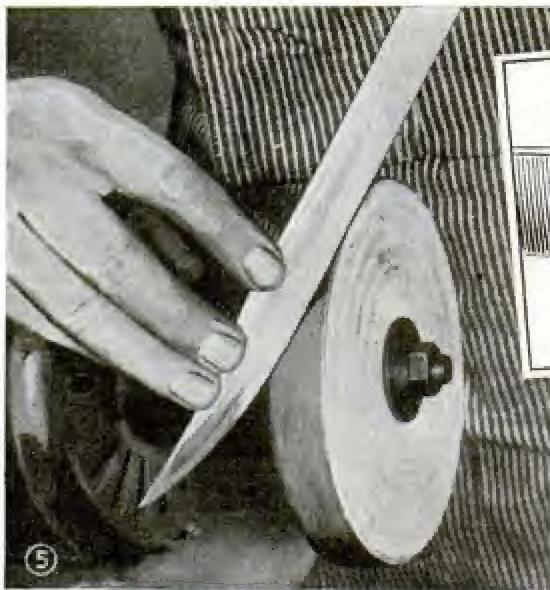
By Alexander Maxwell

WELL tempered, razor-sharp knives that keep their keen edge can be ground from worn or broken power-hack-saw blades, obtainable at many machine shops. As these blades are made of hard steel alloy such as molybdenum, which is so tough that a file will not cut it, shaping the blades must be done on a wet grind-stone or very lightly on an emery wheel. Heavy pressure results in overheating and withdrawing the temper from the steel, which renders the blade useless. When grinding, a blade should be dipped in warm water every half minute or so, but if it is hot enough to sizzle, allow it to cool in the air. Tempered steel should never be immersed in cold water while the metal is hot.

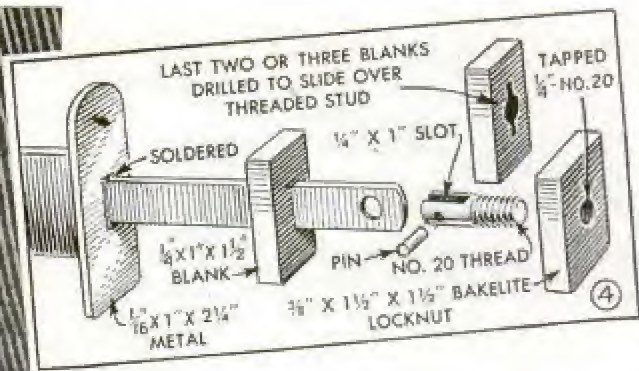
When grinding knives from hacksaw



③ ROUGH-GROUND TAPER ON SIDE OF FINE WHEEL

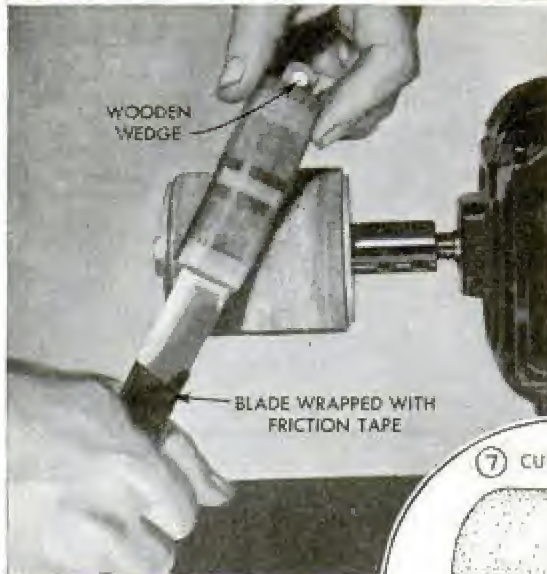


5 USE "GREASE WHEEL" TO REMOVE GRINDING MARKS

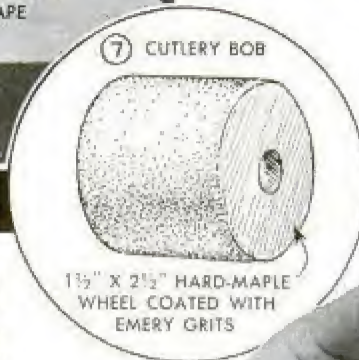


blank gets thinner it tends to heat more rapidly and therefore it is necessary to take light cuts the entire length of the blade. Be sure to keep the blade moving rapidly, not letting it come to rest for an instant. First work on one side and then on the other to cut the two sides down evenly. Smoothing of the blade to eliminate grinding marks is done on an abrasive-coated cloth wheel, often referred to as a "grease" wheel because it is smeared with tallow. Such a wheel consists of a number of muslin buffs glued together after which the edge is treated with glue and rolled in emery powder. Number 120 powder is suitable for the dressing operation. When dry, the wheel is smeared with tallow and is loaded with powdered pumice stone. Then the blade is pressed firmly against the wheel, dragging it the entire length on the wheel as shown in Fig. 5, the wheel rotating away from the edge of the knife. Avoid light pressure as it results in chatter marks that are very difficult to remove. Usually five or six firm strokes are sufficient to produce a smooth surface.

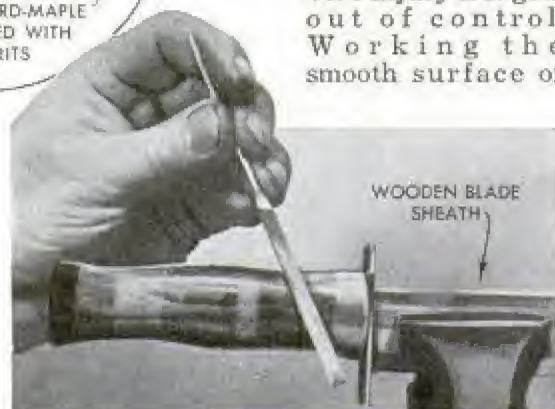
From now on extreme caution must be exercised as the blade has become dangerously sharp. Slippery with grease, it can inflict severe injury if it gets out of control. Working the smooth surface of



6 WORK HANDLE TO SHAPE ON SANDING DRUM



blades, the best procedure is to work on two or three blades at once. As soon as one becomes too warm for the fingers, lay it aside and work on the next. The carving-knife blade shown in Fig. 1, utilizes an entire hacksaw blade. Broken blades are used for shorter knives. Before you start grinding, the shape of the knife is outlined on the blade with a wax crayon, and a full-size pattern on paper should be made for checking. A fairly coarse wheel is used to blank the knife to shape. Rough-grinding the tempered sides to remove excess material, which is a slow process, is done on the side of a fine wheel as shown in Fig. 3. As the



8 FINISH BY DRESSING WITH FINE FILE

the blade down to a silvery sheen is done on a cutlery bob shown in Fig. 7. It is turned from hard maple, then treated with glue and rolled in very fine emery powder or silicon-carbide flour. No. 2F flour will produce a nice luster but for an extra fine finish, make a second bob and coat it with No. 500 silicon-carbide flour. In doing this, use tallow and firm pressure, keeping the blade in constant motion. The knife edge will now be very sharp but will be "feathered," and will not stand up under any practical use. A slip stone rubbed lightly along the shoulders will alter the bevel of the edge to a point where the mechanical strength is sufficient to support the thrust, the bevel being determined by the work for which the knife is to be used. Bevel A in Fig. 2 is best for cutting raw meat where bone may be encountered, bevel B for cooked meat, fowl, etc., and bevel C for boneless meat, sausage, vegetables, etc. As soon as the edge is dulled to the point where it reflects light, the knife should be resharpened. Steel as hard as this does not respond to conventional methods and therefore sharpening should be done on the 500 bob, well greased, and the edge is finished with a fine slip stone.

The method of fitting the knife with a washer-type handle as shown in Fig. 4, is advisable, as the steel is so tough that it cannot be drilled for rivets. The guard is shaped from a piece of sheet metal such as brass. The washers may be Bakelite, sheet plastic, leather, hardwood, metal, bone or any combination of these. To dress the handle to shape on a sanding drum as in Fig. 6, the guard is removed and the washers are put on the shank up to the hole into which a wooden wedge is inserted to hold them. The blade should be wrapped with several layers of adhesive or friction tape, or otherwise covered to protect both the edge of the knife and your hands. A small file is used to dress the handle down until it fits the hand comfortably. Then the washers are removed, the guard soldered in place, using acid flux, and the parts are assembled permanently. Use waterproof tile cement on the washers. Note that the last two or three of them are drilled to fit a compression screw which is pinned to the blade. See Fig. 4. With the washers all in place, the Bakelite locknut at the end is turned up tightly on the compression screw, and the cement, which is squeezed out of the seams, is wiped off. Then the end washers and the locknut are sanded down after which the knife is clamped in a vise so that you can file down the bumps and sander marks from the handle with a fine-cut Swiss file as shown in Fig. 8. The final step is to polish both the blade and the handle on a soft muslin buffing wheel.

Striped Paper on Drawing Board Helps Artist Letter at Angle



One artist who often had to letter a few signs quickly, used diagonally striped paper as a guide in slanting the letters at a uniform angle. The paper was alternately striped black and white and was fastened to the drawing board under his work so that the portions of the paper projecting at the ends and sides caused a tendency for him to unconsciously follow the diagonal lines when forming the letters.

Heavy Timbers Rolled in Place With Empty Nail Kegs

Having several large timbers that were too heavy for one or two men to lift and carry to a building foundation, one workman moved them by slipping an empty nail keg over each end of a timber and rolling it into place. The kegs provided rounded surfaces at the ends of the timber so that it could be rolled easily on fairly level surfaces.



Holder Keeps Blowtorch on Roof While Repairing Eave Gutter



When soldering an eave gutter or metal valley, the problem of where to set the blowtorch while not in use is solved with this holder, which is slipped under one of the shingles on the roof. The holder is made by cutting and bending a piece of sheet metal to the size and shape shown. When slipping the holder under composition shingles, take care not to damage them with the sharp edges of the metal.

Tripod to Support Camp Kettle Improvised From Three Sticks

Providing a simple tripod to hold a camp kettle over a fire is not difficult. Simply cut three stout sapling sticks, insert the ends in an empty can and spread the opposite ends to make a tripod. The sticks



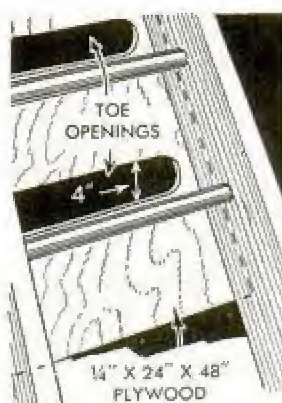
should be long enough to permit a wide spread to keep them from being ignited by the fire. If the can has been opened so that the tin cover is securely attached to one side, you can punch a hole in it to receive a wire hook for supporting the kettle.

A Self-Feeding Fly Poisoner

To make liquid fly poison available to the insects and still keep it out of the way of children, one householder puts it in a bottle and folds several pipe cleaners over the bottle cork before inserting it in place so that they project as shown. The bottle is then provided with a stout rubber band so that it may be inverted and hung by a wire hook from the ceiling. The cleaners serve as wicks to dispense the poison.



Plywood Brace Steadies Ladder

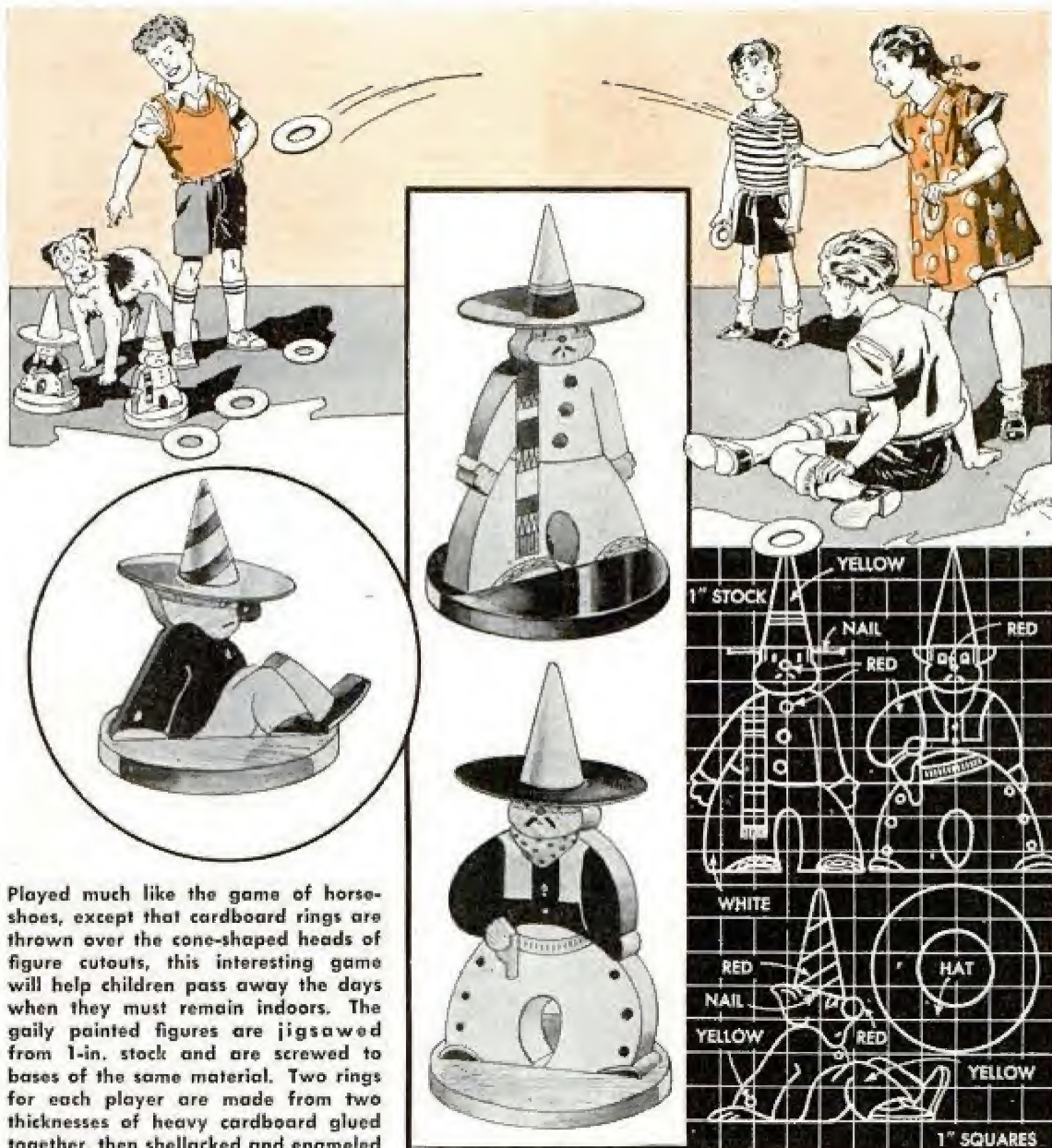


water-resistant materials. Toe openings are cut in the plywood as indicated so that the user can climb the ladder or stand on any rung. To be most effective, the brace should be placed about 3 ft. below the top of the first section.

Installing a Fuel Pump Easily

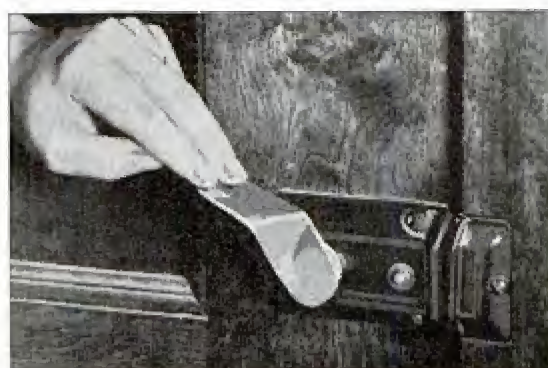
The stiff springs in the fuel pump of a car make the job of installing it squarely against the engine crankcase flanges a hard one if the cam that works the pump arm happens to be stopped on a high spot. When the pump does not go into place easily, just turn the engine with the crank, or touch the starter button gently, until you can feel the pump slip down as you press on it when the cam stops on a low spot.

Indoor Fun With This "Ring-Horseshoe" Game



Played much like the game of horseshoes, except that cardboard rings are thrown over the cone-shaped heads of figure cutouts, this interesting game will help children pass away the days when they must remain indoors. The gaily painted figures are jigsawed from 1-in. stock and are screwed to bases of the same material. Two rings for each player are made from two thicknesses of heavy cardboard glued together, then shellacked and enameled

Handle Soldered on Door Lock Makes It Easy to Release



If you have a door lock of the type shown and often have to open the door when both hands are full, a piece of sheet metal soldered to the knob will enable you to release the lock with your elbow. The exact shape to make the handle will be determined by your own particular requirements.

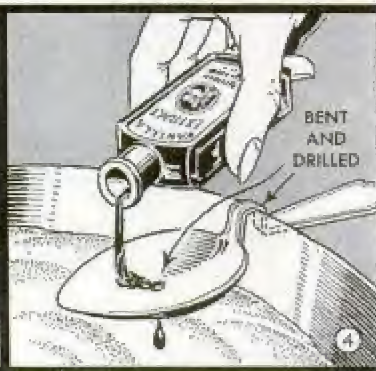
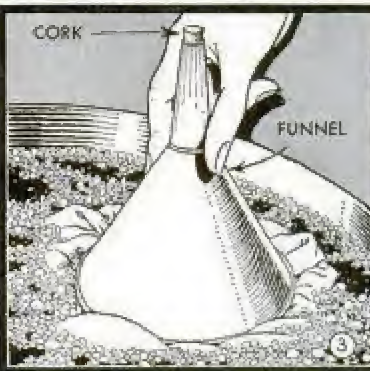
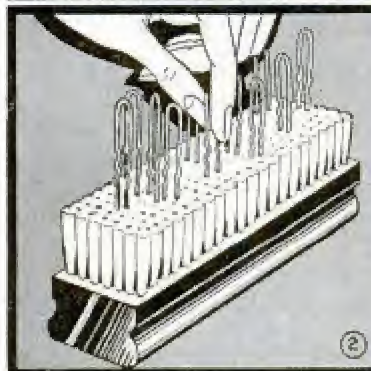
—F. T. Brown, Chicago.

☐ You will find that laundered flannel garments will dry very soft if they are rinsed in water to which has been added $\frac{1}{2}$ teaspoonful of powdered borax for each quart.



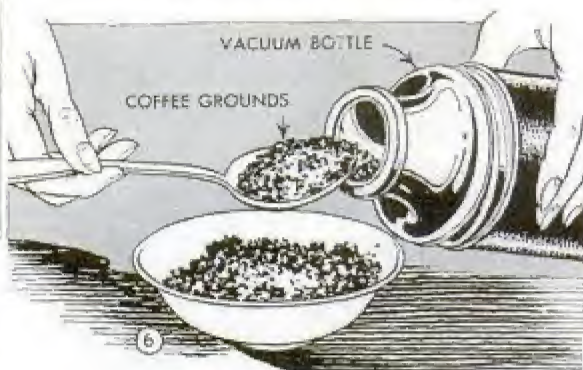
Solving HOME

1—Hooked over the head board of a bed, an ordinary wire coat hanger provides an ideal holder for an extra pillow to form a comfortable back rest. Note that the open end of the pillowcase is pinned to the hanger crossbar, and a folded handkerchief protects the bed from scratches. 2—When not in use, hairpins are kept in neat order by sticking them in the bristles of an inverted hand brush, where they can be selected easily whenever desired.



5—Where it is necessary to remove a knitting needle while working on a garment, pipe-stem cleaners make excellent stitch holders, as both ends of them can be bent back easily to keep stitches from being slipped off accidentally.

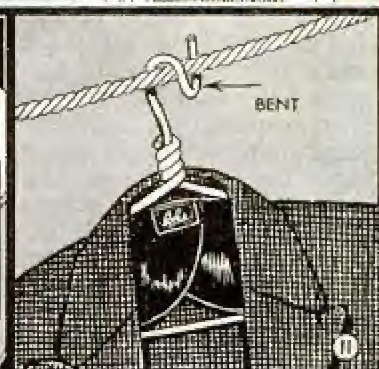
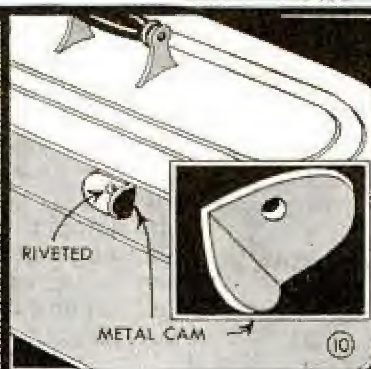
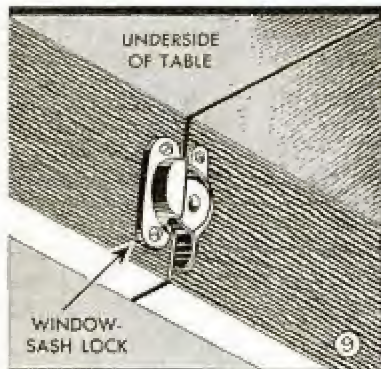
3—Washing garments in cleaning fluids during cold weather is accomplished rapidly without dipping your hands in the fluid by using a simple vacuum-type dasher, consisting of a funnel to which a tight cork is fitted. 4—One housewife adds flavoring extract to cake batter, one drop at a time, by pouring the extract in a tablespoon, which has been drilled and bent to slip over the edge of the mixing bowl. 6—When a vacuum bottle is difficult to clean due to a thin film of milk deposited on the inside, just put a few coffee grounds in the bottle and shake it for several minutes. This will clean the container quickly and leave the inside sparkling.



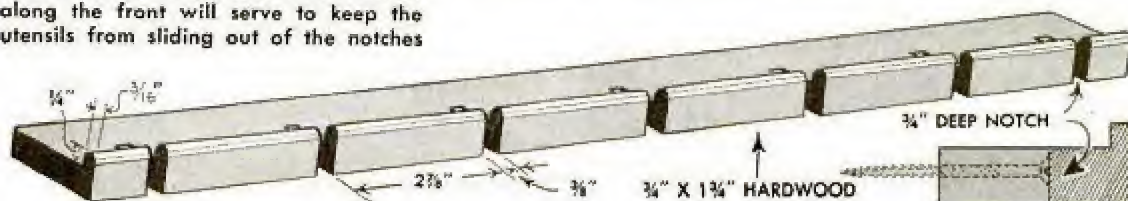
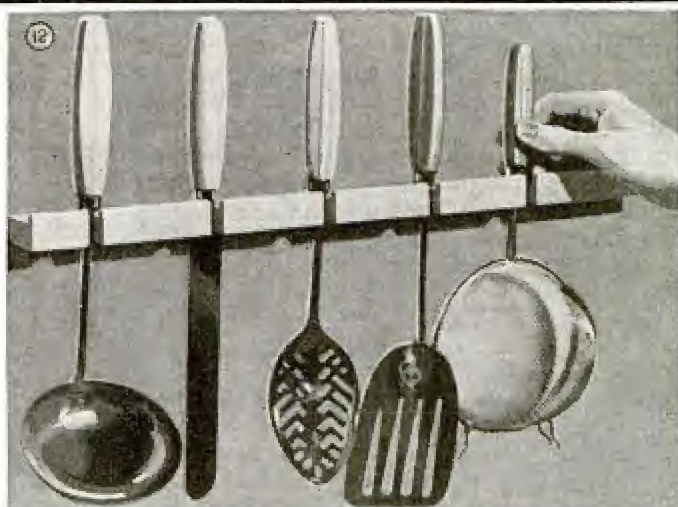
PROBLEMS



7—Candles won't wobble in holders if they are fluted near the bottom with a keyhole saw as shown. 8—Occupying little space in the pantry, these individual vegetable bins can be removed for cleaning without loosening any screws



9—If you have an extension table that is not provided with a locking device to keep it closed tightly, a window-sash lock screwed to the inside of the apron will serve the purpose. 10—Riveted to one side of a wash boiler near the top, a small metal cam solves the problem of raising a tight-fitting lid without danger of spilling hot water. 11—Next time you hang a suit or coat on the clothesline, bend the hanger hook as indicated to prevent it from slipping off in case a sudden wind comes up. 12—This neat utensil holder is just the thing where drawer space in the kitchen is limited. It is formed from a single piece of hardwood by cutting equally spaced notches along one edge and rabbeting the top surface as shown. If a circular saw is not available, strips fitted and tacked along the front will serve to keep the utensils from sliding out of the notches



Paint Adheres to Clean Building Better Than Dirty One



Time spent in cleaning the surface of a building before repainting it, especially if it is heavily coated with dirt and soot, will be well worth while in making the new paint look neater and last longer. In many cases where a new paint job is impossible, cleaning the building will greatly improve its appearance. A solution of trisodium phosphate powder and water makes a good cleaner for this purpose. If available, rubber gloves should be worn to protect the hands while doing the work.

—A. M. Wettach, Mt. Pleasant, Ia.

Cobble Stones Imitated Easily With Cement Blocks

I wanted a cobble-stone garage, and not being a stone mason, I produced a cobble stone effect by making it of cement blocks faced with stones. To make the blocks, first build a few wooden molds of the desired size with two opposite sides open. Then level off and pack down a square of ground equal to the size and shape of the molds.

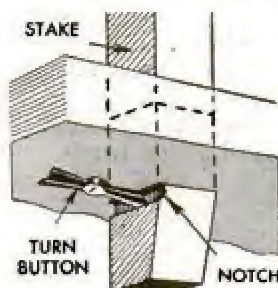


W.T.M. Concrete

Now wet the ground and place the cobble stones on it, driving them into the ground a distance equal to not more than half their thickness. Next set a form over the stones and fill it with cement. When this has set, remove the form and wash off the dirt from the stones. This will give you a block with stones anchored securely in one side. By working out the stone design carefully in each block, you can make a wall that will resemble closely one that was laid up with stones and mortar.

—A. H. Waychoff, Phoenix, Ariz.

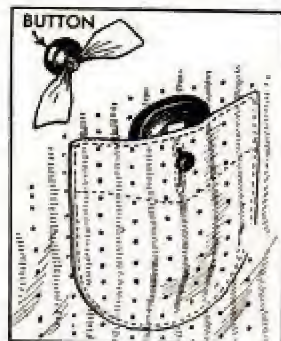
Side Stakes Locked on Truck Body By Use of Turn Buttons



To avoid the loss of loose stakes from the body of a truck, one operator notched each stake at a point flush with the underside of the body, as indicated. Then a turn button was screwed onto the underside of the body so that when it was turned at right angles to the stake, the end of the button projected into the notch, thus preventing the stakes from jumping out. It is necessary that the button be screwed down so it is rather hard to turn and thus prevent it from loosening and allowing the stakes to fall out.

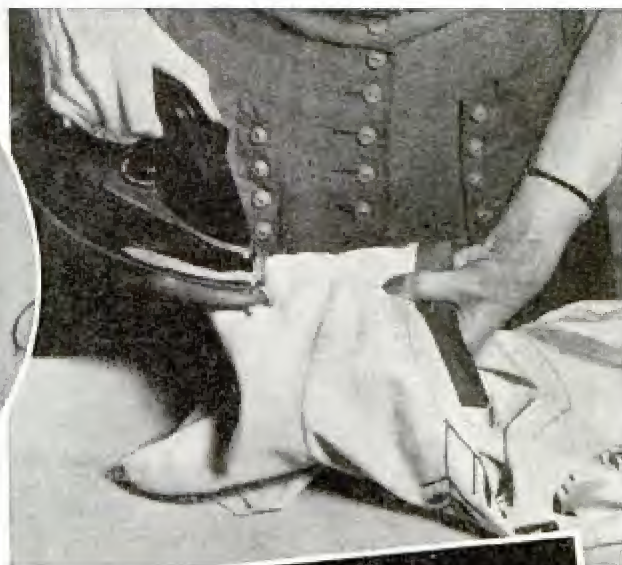
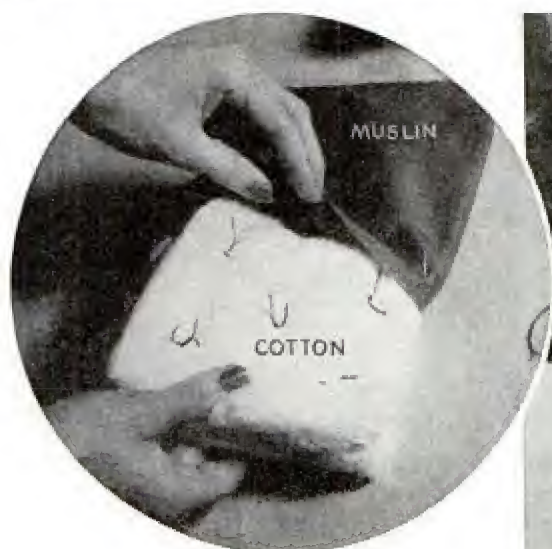
Loss of Spectacle Case Avoided By Buttoning It on Pocket

To guard against losing a spectacle case when carried in the pocket of his shirt, one workman attached a bead button to the side of the case so that it would engage the pocket buttonhole. The button was fastened to the case quickly by slipping a small piece of cloth through the eye and then using strips of cellulose tape to secure the ends near the top of the case.



Before using a new paintbrush, it's a good idea to slap it against the palm of your hand several times to shake out any dust that might have collected in the bristles while the brush was in the store.

These Sleeve Pads Help in Ironing Garments



If you do not have regular sleeve pads and boards available to do a neat job of ironing garments, these substitutes will serve the purpose nicely. For ironing high puffed sleeves you can use a pad of the kind shown above. It is made by folding several thicknesses of cotton to form a rectangle about 4 by 6 in., after which the layers are tacked in several places with thread and then slipped into a cover made of muslin or similar material. On work requiring a regular sleeve board, you can use one made as shown at the right. Several large magazines are rolled and tied at the center and ends, then padded with an old Turkish towel and slipped into a cover made of muslin.

—Benj. Nielsen, Aurora, Nebr.



Pieces of Thread Brushed From Cloth With Abrasive Stick



When ripping the seam of a garment by cutting the thread, pieces of the latter that adhere to the cloth where they are difficult to brush off can be removed with an abrasive stick of the type used in manicuring. Use the stick with a brushing motion and the abrasive surface will pick up the threads without damaging the garment.

Making Antique Panels

To antique a wood panel, combine raw sienna with a bit of raw umber and a touch of Venetian red. Dilute this mixture with thin glue size. After the finish is dry, apply a thin coat of bleached shellac and rub down with fine sandpaper. Repeat until surface is smooth. A final finish may be made of flat lacquer or rubbing varnish.

Frozen Shut-Off Valve Thawed With Exhaust From Motor



When the underground shut-off valve of a large city water pipe could not be operated because it was frozen, one workman slipped a hose over his truck exhaust pipe and then lowered the other end of the hose down in the valve housing as indicated. In this way, heat provided by exhaust from the running engine accomplished the task in a few minutes.

Marking Thread Notch in Spool Makes It Easy to See



If it is difficult for you to see the tiny notch made in a spool for securing the loose end of the thread, just mark it with ink or a colored crayon. This will make it visible at

a glance, and also serve as a reminder to secure the thread end, thus preventing the thread from tangling with other spools.

Protect Your Guns Against Rust

Rusting of guns may be avoided by depositing in the gun cabinet a lump of gum camphor half the size of one's fist. This absorbs humidity within the cabinet and gives permanent protection, regardless of atmospheric changes. The same idea is applicable to a mechanic's tool chest. Brightly finished scales, micrometers, etc., when

handled frequently are not only subject to atmospheric changes, but also to unsuspected dampness of the hands. A small lump of camphor no larger than a hazelnut in each drawer of the chest is sufficient. The camphor will be ineffective if tools are put away damp with moisture from handling them. They should first be wiped with a cloth or chamois that has been dampened with a neutral oil or plain liquid vaseline and then filled thoroughly with a good rust inhibiting grease, or even plain yellow vaseline from the dime store. Automotive greases should be avoided for this purpose as they are not intended for such uses. A good compound for impregnating the cloth consists of equal parts of anhydrous lanolin and vaseline. Warm them together over a slow fire to remove all traces of moisture. A few lead or zinc shavings will neutralize any acidity present. When cool, strain and whip thoroughly with an egg beater and pack in cans.

Deep Irrigation for Trees



A couple of wooden columns sunk about 3 ft. into the ground on each side of a small tree will be a great help in getting water to its roots when required. Water is run into the columns and passes into the ground around the tree roots through holes drilled in one side of each column, the holes being covered with screen wire to keep dirt from falling into the columns.

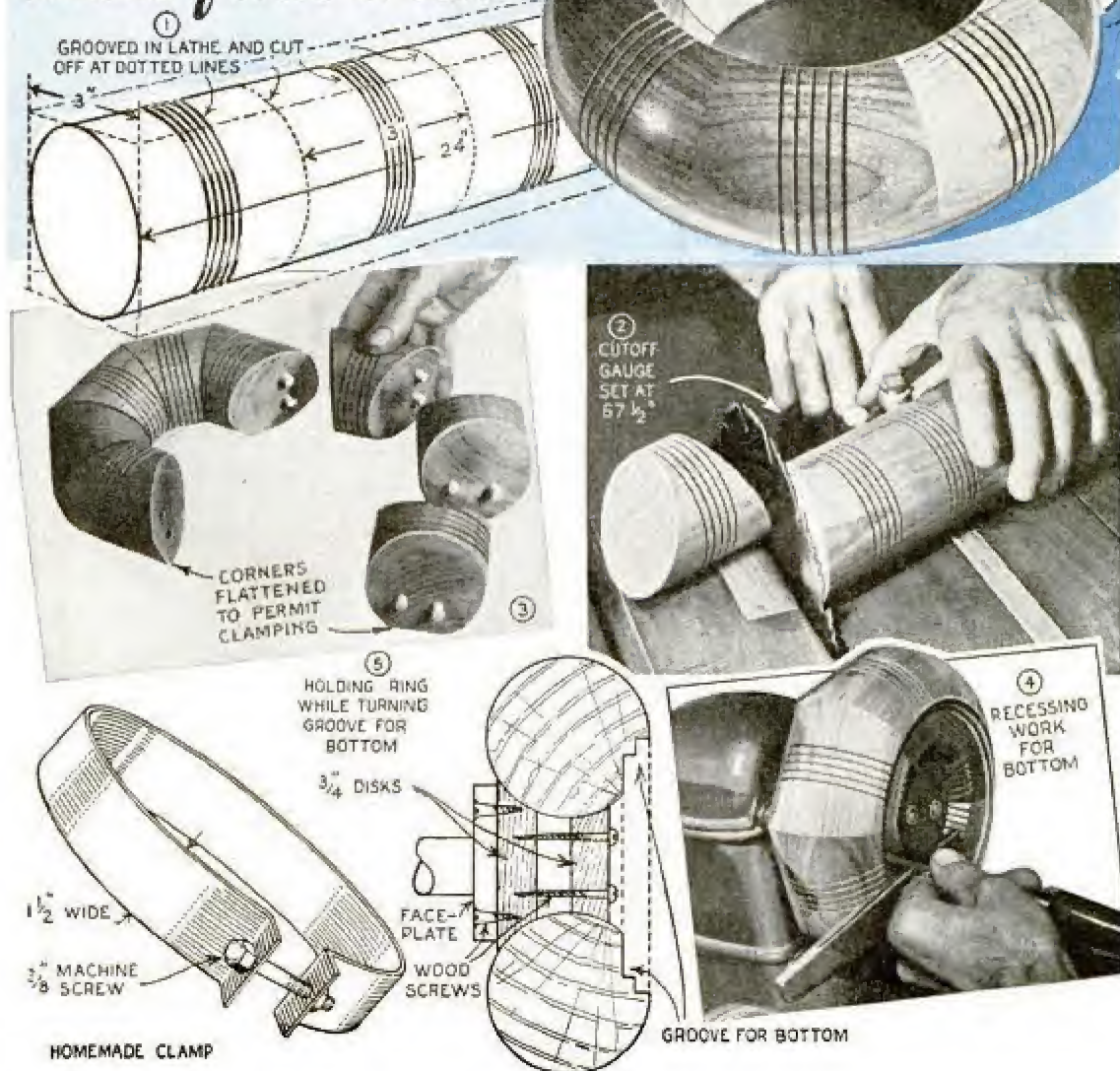
Stainless Nail-Hole Filler

Frequently decorators fill nail holes with pure yellow beeswax or tinted nonshrinking crack fillers instead of an oil putty, which may leave oil rings unless used with a linseed oil stain. Filling nail holes is done after a stain coat and before the finish coat.

☛Lace will look nice longer if, instead of using starch, you dip it in water in which two lumps of sugar have been dissolved.

BOWL

made from a stick

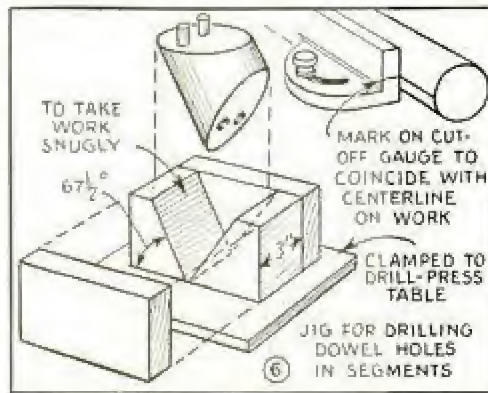


CONTRARY to conventional methods where faceplate grooving is limited to cuts encircling the work, here's a way to turn a bowl having vertical grooves cut in the side, which is unusual in appearance and perplexing as to how it was done. The secret, of course, is the use of a stick instead of the customary block, first grooving it and then cutting and assembling it to form a ring which is turned in the usual way. Other advantages are that no end grain is exposed, and it is possible to obtain two-tone effects of contrasting woods in segments instead of horizontal layers.

Segment assembly and trick chucking combined to produce unusual bowl without end grain

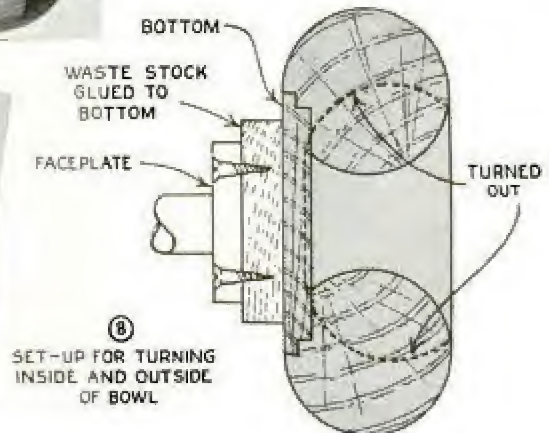
By Benjamin Nielsen

The stick is turned a uniform diameter of 3 in. its entire length and 1/16-in. grooves are cut 1/16 in. deep, each group of grooves being spaced 3 in. apart from center to center. The stick should be 30 in. long although the portion used for the bowl requires only 24 in. The extra stock enables you to hold the piece accurately against the miter gauge of the circular saw as the piece becomes shorter. The miter gauge is set at 67 1/2 degrees, which cuts off the stock at a 22 1/2-degree angle to the squared end. To test whether you are cutting the angle correctly, take a length of 1 by 2-in. stock



which it is an easy matter to line up the centerlines of the work with this index mark on the gauge as shown in Fig. 6. Although it is possible to hold the work against the miter gauge by hand, it may turn slightly while sawing and therefore it is best to clamp the work securely to the gauge.

Next, the segments are drilled for short dowels, which requires the use of a jig like the one shown in Fig. 6 to hold each segment at right angles to the bit. Then the segments are glued together and the corners are flattened as in Fig. 3 to permit a band clamp like the one shown in Fig. 5 to be applied. Use a waterproof, resin-type glue, applying a second coat to the end grain

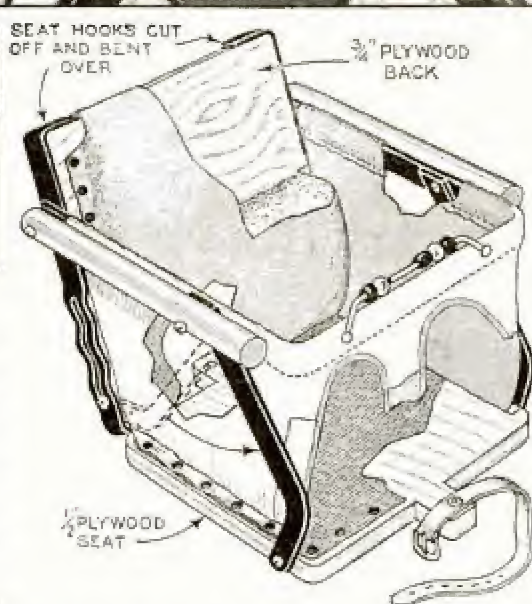
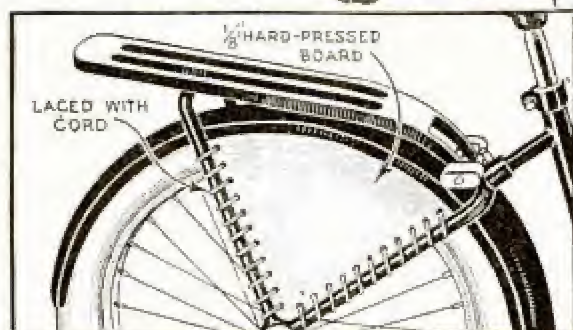


and cut off four pieces, turning the piece upside down for each cut and being sure that the pieces are all the same size. Then fit the pieces together on a sheet of paper. The ends of pieces 1 and 4 should come flush on a straight line previously ruled on the paper. If this is the case, the miter gauge has been set correctly. Then proceed the same way in sawing off the segments from the stick. These should be 3 in. in length minus the thickness of the saw cut, because the saw should be centered on the starting mark for each cut instead of on one side of the mark. In cutting off the segments, it should be remembered that the piece must be turned over exactly 180 degrees for each cut. To do this accurately, you mark two lines diametrically opposite each other on the stick. Then mark the edge of the miter gauge exactly $1\frac{1}{2}$ in. above the surface of the saw table, after

just before pressing the contacting surfaces together.

Mounting the ring on a faceplate for recessing the bottom as in Fig. 4 requires a special chuck as shown in the sectional detail of Fig. 5. Here a disk is attached to the faceplate and is beveled to fit the ring, the disk being left on the faceplate so that a second beveled disk can be screwed to it to automatically center the ring. After cutting the rabbet, the bottom of the bowl is glued in place and the work is turned end for end on the faceplate as in Fig. 8. A piece of paper between the scrap block and the bottom of the bowl will help in separating the two when completed. In turning the outside to shape, just enough stock is removed to round it nicely and to avoid cutting down below the grooves. Finally, the inside is hollowed out as shown in Fig. 7, following the contour indicated.

Tandem Seat to Carry Child Safely on Bicycle



Riding a small child on a bicycle can be done safely with this tandem seat, which is strapped to the luggage carrier. A simple footrest is provided and the rear wheel has a guard to keep the child's feet from accidentally getting into the spokes. The seat is of the type that hooks over the back of an auto seat and is altered to make it suitable for use on a bicycle. For most seats of this type, the alteration will consist only of providing a wooden bottom and back. In the original, the seat hooks were cut off and bent over the upper edge of the back piece where they were screwed to the back to hold it in place. The bottom was cut to size and screwed to the arm-rest supports. Projections were left on the front and rear edges of the bottom for at-

taching straps with which the seat is fastened to the luggage carrier. The guards for the rear wheel are pieces of hard-pressed board laced with cord to the rear fork and luggage-carrier support.

—Ethel E. Bangert, Sacramento, Calif.

Badly Cracked Ceilings Repaired Easily With Water Glass

If the plaster on your ceiling is badly cracked and has loosened from the lath in spots, a coating of sodium silicate (water glass) on the lath side of the ceiling between the joists is an economical method of repairing it temporarily until it can be replastered. Buy 3 to 6 gals. of water glass, depending on the size of the ceiling. Add an equal amount of water, mixing about a pailful at a time. Apply the mixture generously with a large brush. This will fasten

the loose plaster to the lath, sealing the cracks and tightening the whole ceiling. Even bad cracks and sags can be taken care of easily by forcing the plaster back into place before applying the mixture, using a prop to hold the plaster until the mixture hardens, which will take an hour or so.

❏ Paper that sticks to table tops and other polished surfaces can be removed easily if it is first softened with olive oil.

Hedge Shears "Hollow Ground" With Sanding Block

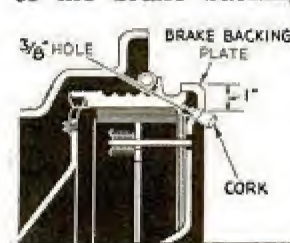


An easy way to maintain the hollow ground inside surface of a pair of hedge shears is to use a piece of emery cloth. This is tacked to a wooden block that has a convex surface formed on one side to conform to the surfaces of the shears. When sharpening them, the abrasive-covered block is rubbed back and forth over the inner surfaces of the blades.

—Richard I. Salzer, Baldwin, L. I., N. Y.

Keeping Dust Out of Car Brakes

Better action and longer life of brakes result by keeping them free of dust and grit. An easy way of doing this on the rear wheels is to drill a hole 1 in. below the top of the brake backing plate. Then, with



compressed air, any accumulation of dust and grit can be blown out. A cork should be kept in the hole to prevent the easy entrance of additional dirt. This idea also may be

used on the front wheels but the ease with which they can be removed and replaced makes this hardly necessary. Where cars are operated in sandy country or are run in wet sand it may be necessary to remove the wheels and wire-brush the linings in order to get out imbedded abrasive matter. Blowing out the brake assembly, however,

proves highly effective except in those cases where water has entered with the gritty matter.—C. E. Packer, Chicago.

Toothbrush Cleans Egg Beater

It's a simple job to clean the blades of a rotary egg beater if you use a toothbrush. With the brush you can get into the restricted places around the blades where it is difficult to do a good cleaning job with a cloth. Keep the brush around the sink and you will find many other uses for it, such as cleaning graters, choppers and similar kitchen utensils.



Chain and Padlock Used as Unit



Where a chain and padlock are used together, cut off the shackle of the lock and weld the chain to it as indicated. This makes them into one unit which is handy, and it also makes it possible to provide a padlock shackle of any size desired merely by using a suitable length of chain.

Transposed Springs Repair Clock

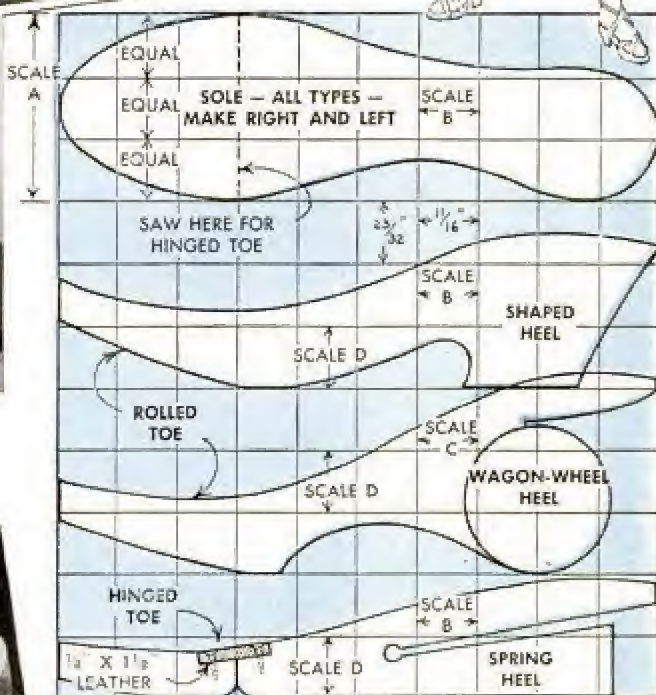
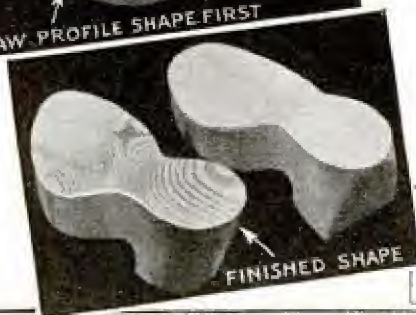
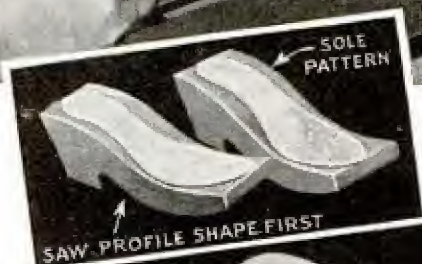
Eight-day clocks of the type that strike sometimes fail to operate satisfactorily because of a roughened surface on the mainspring. When this condition exists, the clock can be made to operate correctly by substituting the striking spring for the mainspring. The reason for this is that fine dust works into the coils of the mainspring and acts as an abrasive as the spring very slowly unwinds over a period of eight days. On the other hand, the striking spring moves rapidly at regular intervals and dust has less tendency to roughen its surfaces.

—E. T. Gunderson, Jr., Humboldt, Ia.

☛ To prevent the inside of a cook-stove oven from rusting, leave the door open for an hour or so after baking.

WOODEN SHOES ♦ ♦ ♦

Three Smart
Styles for
Beach or
Street ♦ ♦ ♦

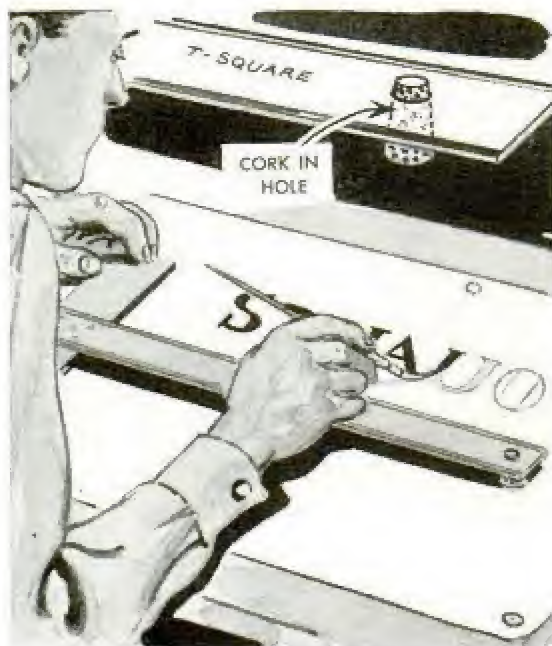


SHOE SIZE	SCALE A	SCALE B	SCALE C	SCALE D
2	2 1/8	1 1/4	1 1/4	1 1/4
3	2 3/8	1 3/4	1 3/4	1 3/4
4	3 1/8	2 1/4	2 1/4	2 1/4
5	3 3/8	2 3/4	2 3/4	2 3/4
6	3 5/8	3 1/4	3 1/4	3 1/4



You can make these shoes from blocks of hardwood in a couple of hours, using a scroll or band saw. Start with full-size patterns of the profile and sole shapes, making guide squares according to the scale at the left. The shaped-heel style requires sanding. Leather or fabric ties are attached with thumbtacks or fancy upholstery tacks

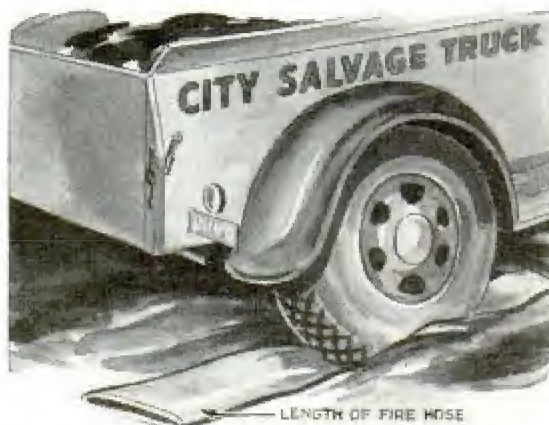
T-Square Fitted With Cork Foot Provides Artist's Arm Rest



Needing a rest to steady his hand while lettering small showcards, one artist uses his T-square as shown. A hole was drilled in the blade near one end to take a cork, which raised the blade slightly above the work, thus providing an ideal rest without having to resort to a piece of extra equipment. When not in use, the cork can be removed so that the square can be used for its regular work.

Driver Uses Piece of Fire Hose To Remove Truck From Mud

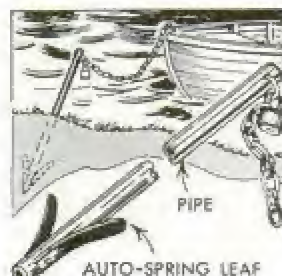
Noting that a quantity of old fire hose was to be discarded, the driver of a municipal truck salvaged a couple of lengths which he carries to aid in removing his truck from mud holes when chains are not used. Fire hose of this kind is wide and



its coarsely woven cotton surface affords the necessary traction for tires. Being waterproof, the hose can be washed off easily after use and stored in the truck.

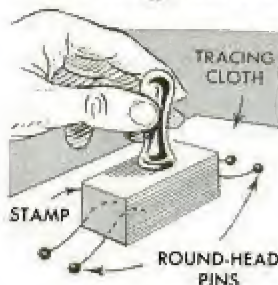
Stake for Tying Boat at Bank Cannot Be Pulled Up

After having his rowboat used several times by persons who merely pulled up the anchoring stake from the bank without tampering with the lock, one sportsman used a self-anchoring



stake. It consists of a length of pipe having two pieces of auto-spring leaf bolted to the lower end to form wings. When the stake is driven into the ground, the wings spread under the soil and prevent removal of the stake unless it is dug up with a spade.

Tracing Cloth Is Spread by Pins For Imprint of Rubber Stamp



To hold tracing cloth smooth for the clear application of a rubber stamp, one artist inserted round-head pins at an angle in the ends of the stamp block as indicated. In this position, the

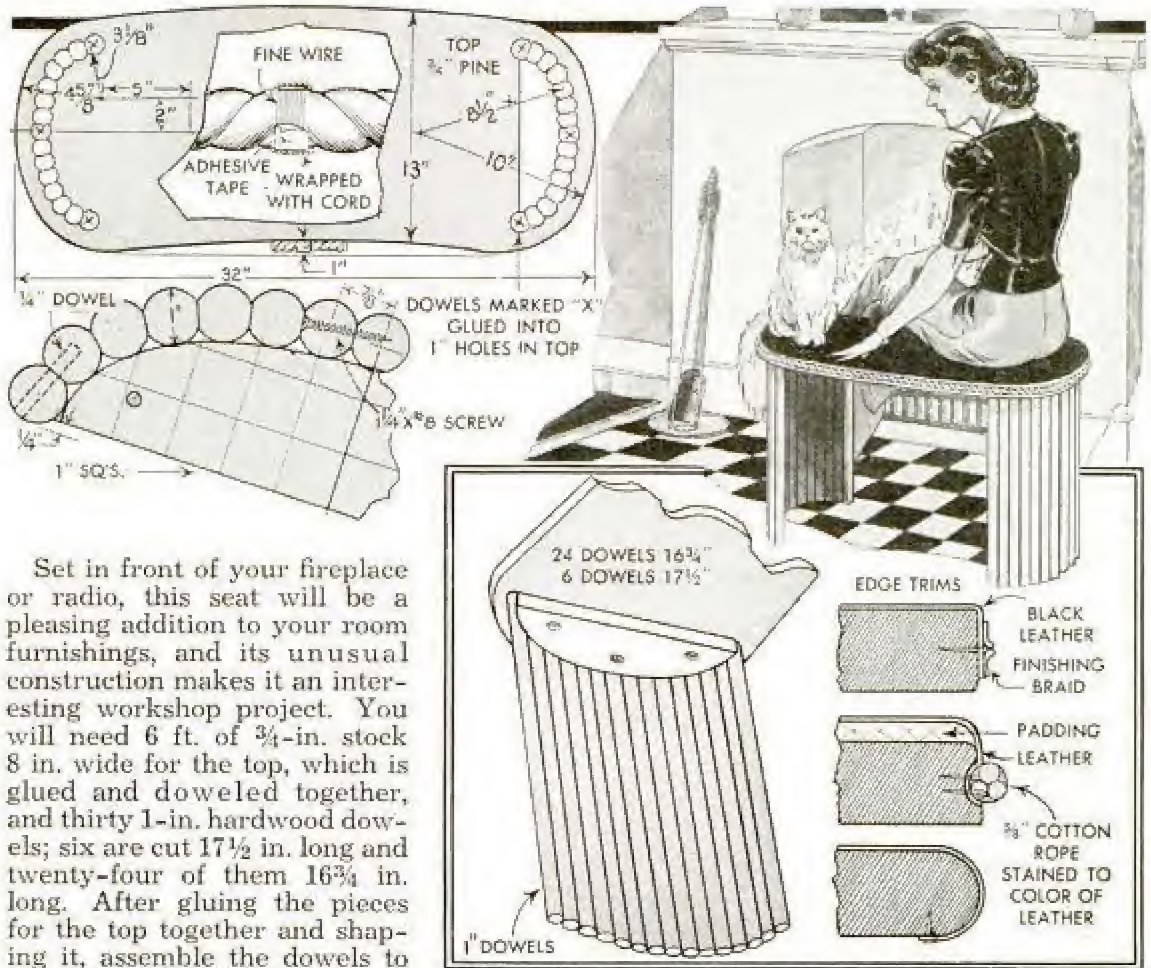
pins contacted the cloth before the stamp and spread it smoothly under the pressure applied to make the imprint.

A Fire-Retarding Paint

A paint that will help retard the spread of small fires and afford reasonable protection for surfaces where insulation of other types might be too expensive, consists of white lead, 41 percent, borax, 32 percent, raw linseed oil, 22.8 percent, turpentine, 3.6 percent, and japan drier, .6 percent. The borax is ground finely and mixed with the linseed oil to form a paste, which is then mixed with the white lead. The lead reacts chemically with the borax paste to form special heat-repellent properties. The paint is restricted to interior use because of the reduction in oil content which makes it non-resistant to weather if used on surfaces outside of a building.

—H. J. Kerber, Chicago.

Fireside Seat Has Legs Formed From Dowels



Set in front of your fireplace or radio, this seat will be a pleasing addition to your room furnishings, and its unusual construction makes it an interesting workshop project. You will need 6 ft. of $\frac{3}{4}$ -in. stock 8 in. wide for the top, which is glued and doweled together, and thirty 1-in. hardwood dowels; six are cut $17\frac{1}{2}$ in. long and twenty-four of them $16\frac{3}{4}$ in. long. After gluing the pieces for the top together and shaping it, assemble the dowels to form the end units, each of which consists of twelve short dowels and three long ones. The latter are used at the sides and in the center of each unit, and are glued into holes in the top. As indicated in one of the details, the dowels are flattened on opposite sides and are glued and screwed together. The screws are staggered and a $\frac{1}{4}$ -in. dowel is used instead of a screw in the last two dowels at one side

of each unit to avoid having a screw head exposed. Curved blocks screwed to the underside of the top at both ends to bear against the dowel units, add rigidity. The units can be glued to the blocks, if desired. Complete the seat by upholstering the top and trimming the edges, three methods of which are shown in the lower right-hand detail.—A. M. Youngquist, Toledo, Ohio.

Garment Drawstring Inserted Easily With Bicycle Spoke

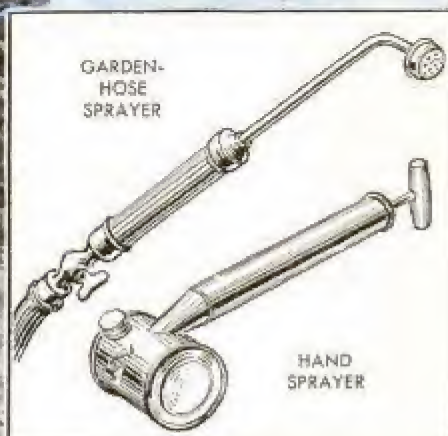
Running a drawstring through the hem of a garment is neither a difficult nor tedious job if you use a spoke from a bicycle wheel. Just fasten the string to the bent end of the spoke and push the spoke through the hem as indicated. If the string is too wide to tie it to the spoke, attach it with a small piece of adhesive tape.

☐ A spring-type clothespin with your name imprinted on it is handy for clipping your rubbers together when attending parties or other gatherings.



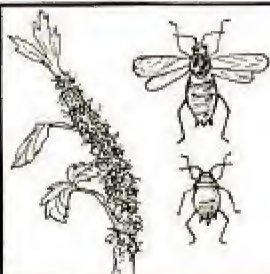


RID Your



By W. Clyde Lammey

with spray



APHIDS

These plant lice attack many trees, shrubs, and plants. To control them on tender plants and shrubs, apply nicotine or soap sprays or dusts, repeatedly. Root aphids, bluish-green in color, are discouraged by wood ashes and mixture of tobacco dust and air-slaked lime in equal parts.



ASIATIC BEETLES

Cinnamon-brown in color, they may be found in the soil around plants. They feed at night, reenter the soil at daybreak, and are detected mainly by the damage. Spray plants with lead arsenate. When a lawn is infested, apply powdered lead arsenate 3 lbs. to 1,000 sq. ft. of surface.



JAPANESE BEETLES

Damage many plants and trees. Fruits may be protected to some extent by spraying with a solution consisting of hydrated lime, 5 oz., and wheat flour, 2 oz., in water, 1 gal. For infested lawns, spread powdered lead arsenate, 5 to 10 lbs., mixed in four times its weight in sand for 1,000 sq. ft.



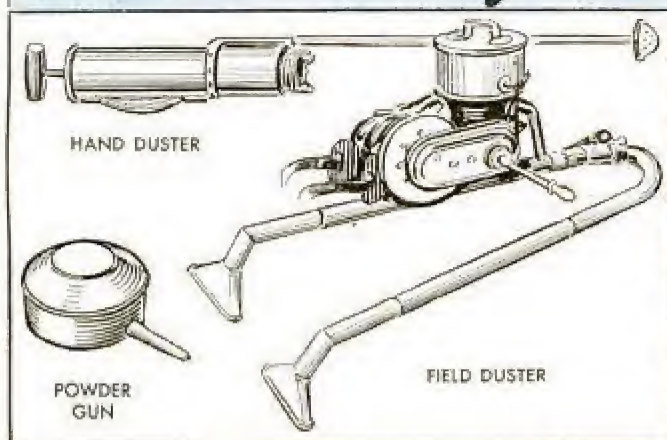
LINED PLANT BUGS

Zinnias are often injured by lined plant bugs. Knocking the bugs into a can of water filmed with kerosene is one fairly effective method of reducing their number. Nicotine may be dusted or sprayed on the plants. Be sure to keep a sharp watch for the bugs when the plants are young.

WHEN tendrils and branches of choice plants and shrubs show signs of withering or drooping, and when seedlings or transplants in the vegetable plot take on a sallow color and refuse to grow with ordinary vigor, no time should be lost in getting busy on the bugs with sprays and dusts. At the top of the page are shown some simple and inexpensive hand sprayers and dust guns for effective application of dusts and sprays. Manufacturers generally give detailed instructions regarding their operation. Likewise, makers of sprays and dusts tell exactly how to mix and apply them either dry or in solution. Although commercial users of large quantities generally follow a given formula, the user of packaged sprays or dusts in small quantities should be careful to follow exactly the maker's directions as it sometimes happens that the effectiveness is determined to a certain extent by the quantity and the means of application. Considering this, the manufacturer has made up instructions for using his product accordingly.

Only an entomologist of wide experience can know and identify all the insects and the true extent of their depredations. So, take a round dozen of them such as you see pictured here and keep in mind that "bugs" is only a very general term. There are a few

GARDEN *of* BUGS!



and dust

worms thrown in, as you will note, but the list does include several of about the most widespread and exasperating pests that the gardener and flower grower must battle against. For example, take aphids, or "plant lice," as people commonly and aptly call them. They are tiny things and you must look closely to discover them even when they are gathered in clusters as is their habit. Note that in the caption regarding aphids several dusts and sprays are recommended. One thing to be kept in mind is that very often the exact spray or dust used is not as important as persistent application. One can't just spray or dust once or twice in haphazard fashion and expect the bugs to leave. It is generally necessary to keep after them continually. Often, in heavy infestations of certain insects as for instance with aphids, it becomes necessary to risk a certain amount of damage to the plant or shrub by continued spraying or dusting to get rid of the pests.

You will notice from the captions accompanying the illustrations of the various insects, that often a single spray or dust has been found effective against a number of them. Old standbys are the tobacco dusts and nicotine sprays, rotenone and pyrethrum dusts and sprays, and arsenate of lead. Insecticides fall into three classes: stomach poisons, contact poisons, and fumigants. The latter are used more commonly in greenhouses and other enclosures.

ROSE LEAFHOPPERS

Similar to aphids, the sucking leafhoppers, tiny, beetle-like bugs, attack nearly all rose plants, sapping vitality and marring beauty of foliage, as well as transmitting diseases to it. Spray with a nicotine solution or pyrethrum on the leaves when the young leafhoppers first appear.



TARNISHED PLANT BUGS

Dahlias, zinnias, asters, chrysanthemums, are susceptible. Adult bugs are $\frac{1}{2}$ in. long, brown, with black and yellow streaks, found under stones, leaves, in bark, and among some weeds. Pyrethrum spray or dust, and sulphur dust are moderately effective. Clean up trash and weeds.



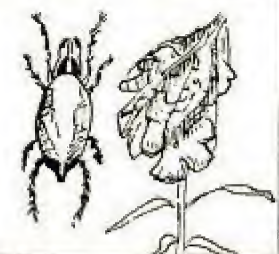
RED-BANDED LEAF ROLLERS

A leaf rolled up tightly, or sometimes several leaves caught together in a web, forms the home of a leaf roller caterpillar. Spraying or dusting should be done early enough to kill the pests before they have accomplished much leaf rolling. Lead arsenate has been found to be an effective spray.



RED SPIDERS

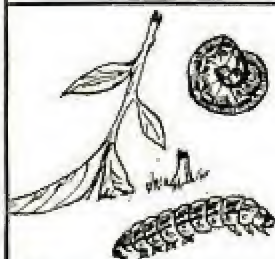
The red spider is really a mite. It sucks the life from plants and vegetables in in house, greenhouse or garden, and also attacks many trees and shrubs on the underside of leaves. A powdery white coat betrays the spider's presence. Spray with lime-sulphur, rotenone or pyrethrum.





BAGWORMS

Spindle-shaped bags seen on arbovitae, red cedar, willow, maple and other trees and shrubs, are "portable" houses of bagworms. Pick and burn all of the bags to destroy the eggs. Spray or dust the infested trees and plants with lead arsenate when the larvae feeding period starts.



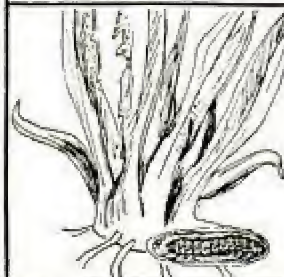
CUTWORMS

These worms will attack young garden plants and some ornamental seedlings. To control them, scatter a poison bran mash around the plants in the evening just before dark, as the cutworms dine at night. Early in the morning the mash should be gathered up before birds discover it.



FALL WEBWORMS

These yellow, black-spotted, hairy worms, living in a tent of webs woven over the ends of branches, can cause severe injury to foliage of more than 100 trees of various kinds. Prune the infected branches and carefully burn them with the webs, or spray them with arsenate of lead.



IRIS BORERS

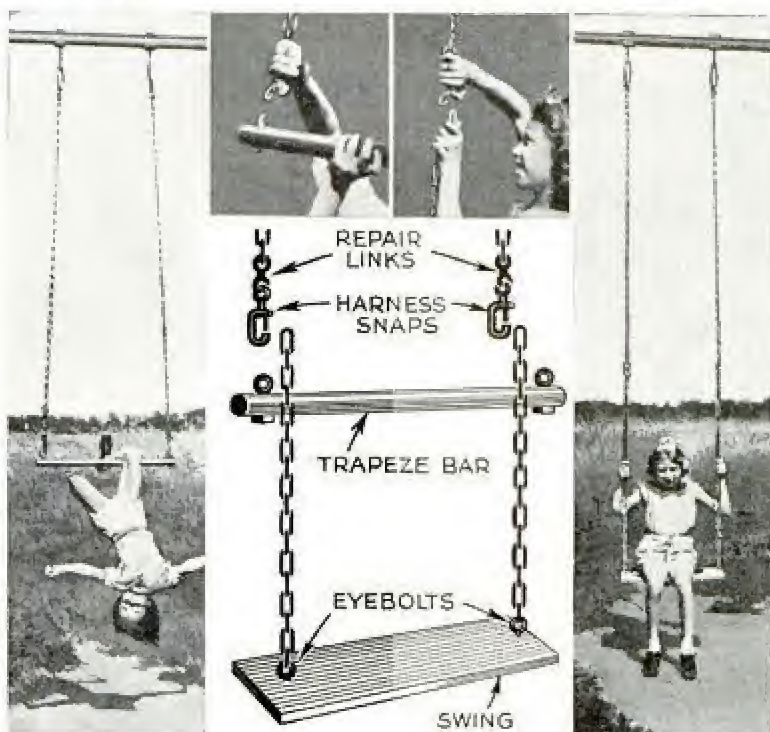
Gnawed iris leaves indicate borers, which travel down to the rhizomes. Burn the worst plants: Pare others and dip in corrosive sublimate, 1 to 1,000 solution, for ½ hr., or roll rhizomes in dry sulphur or gypsum. Spray the new growth of leaves in the spring with arsenate of lead or nicotine.

There is a fourth type known as repellents—materials which keep insects away because of color, odor, or some other property disagreeable to the bug. Concerning the various stomach poisons, lead arsenate in its prepared forms is one of the most effective poisons for use against the chewing insects such as beetles, caterpillars, and grubs. It also is combined with nicotine and with certain fungicides, an example being Bordeaux mixture. Calcium arsenate (arsenate of lime) is sometimes substituted for lead arsenate but it must be applied cautiously to tender foliage. Of the contact insecticides, nicotine is the most widely used, chiefly because of its low cost and great range of effectiveness. Mixed with hydrated lime or sulphur, it is especially useful as a dust. Used as a spray, a common dilution is one teaspoonful to a gallon of water. For additional effectiveness it is often recommended that 1 fluid oz. of liquid soap be added to each gallon of spray to act as a "spreader." In any case, remember to follow the maker's directions when mixing small quantities. The spray kills by contact with the body of the insect, hence it is effective against sucking insects such as the aphids, leafhoppers, and red spiders, although pyrethrum sprays are generally better for the latter.

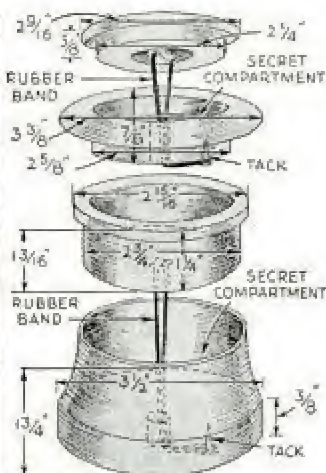
Another way of foiling the cutworm is shown at the top of this page. Cone-shaped paper disks are fitted around the tender transplants and weighted at the edges with soil. This method is used where you cannot use the poison bran mash. In both spraying and dusting either stomach or contact poisons, it is especially important to remember that the material must reach the underside as well as the tops of the leaves and that the contact poisons must strike the body of the insect in order to be fully effective. The best time for spraying or dusting is, of course, difficult to determine by rule, but generally dusting should be done in the early morning, the ideal time being just before the dew is completely dried off, while the air is still, and when there are prospects of a fair day. Spraying can be done quite effectively under the same general conditions.

A Safe, Quick Change From Swing to Trapeze

On swings that have chains instead of ropes, it is possible to make the swing seat and a trapeze bar interchangeable by using a repair link and a heavy harness snap in each chain at the height the trapeze bar is to be attached. Two links are removed from each chain so the length will remain the same. Eyebolts are fitted to the trapeze bar, the ends of the screws being peened so the nuts cannot come off. The arrangement of fastening the chain to the seat with eyebolts as shown, can be improved by providing yokes or hangers of an inverted V-shape at the ends of the seat to prevent tipping easily when children stand on it.



Novel Hardwood Trinket Box Has Secret Compartments



Although this little trinket box appears empty when the lid is raised, it has two secret compartments, which provide an ideal place to keep rings and other small jewelry. To hide these compartments effectively, a careful job of woodturning is required, as all parts should fit perfectly when assembled and the desired finish has been applied. By attaching rubber bands as shown, both secret compartments are kept closed, in case the box is turned upside down. The rubber-band ends and tack heads can be concealed easily by gluing cardboard disks over them.

Checkerboard Made of Inlaid Linoleum Is Durable and Attractive

If you can obtain some inlaid linoleum in colored squares, such as gray or dull blue and ivory, you can make a good checkerboard from them. Such colors are not in harsh contrast and do not tire the eyes, and the soft surface of linoleum is ideal for playing. It is glued to a piece of $\frac{3}{8}$ or $\frac{1}{2}$ -in. plywood and the edges are finished with thin molding all around. Stain and varnish the molding and the underside of the board, and glue a felt or leather disk at each corner. After setting the squares

in place with glue, lay a flat board over them and weight or clamp it down. It may be necessary after the glue has set to use fine sandpaper to get all the edges flush. In case you can't find linoleum in squares you can cut them separately from scrap linoleum of the right colors. Cutting should be done with a heavy, sharp knife.

—A. D. Pitney, Chicago.

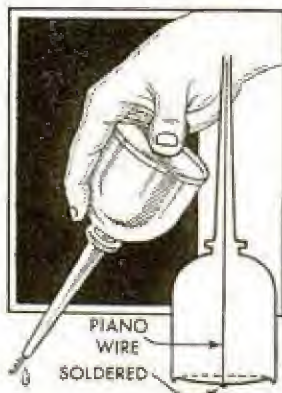
☛ Gum can be removed from clothing by chilling it with ice until it is very hard.

Trailer End Gates Interchanged To Haul Different Boats



Anyone having two boats of different types can utilize one small trailer to haul them by simply making two sets of interchangeable end gates. In this way, it takes but a minute to make the trailer suitable for either boat. The top edge of each end gate is cut to the contour of the boat bottom it is to carry and padded at the points where the bottom of the boat will rest on it. The padding can be pieces of old tires, if available, or you can use several thicknesses of burlap, canvas, or other suitable cloth. The boats can be tied down to the trailer with rope or leather straps as desired.—Herb Clarine, Faribault, Minn.

Wire Soldered at Bottom of Oilcan Prevents Clogging of Spout



To keep dirt from clogging the spout of his oilcan, one mechanic drilled a small hole in the bottom of the can and inserted a length of piano wire to extend just slightly below the top of the spout. A drop of solder was then used to hold the

wire in place and seal the hole. With this arrangement, any dirt that collects in the spout can be ejected quickly by pressing the bottom of the can in the regular way.

Pencils Pointed With Sandpaper Tacked on Drawing Board

Draftsmen and others who must sharpen pencils often to produce fine lines on drawings, will find a small piece of sandpaper handy for this purpose when tacked to the edge of the drawing board as shown. For best results, the sandpaper should be folded in half, abrasive side in, to form a pocket that will catch graphite dust or lead particles that are ground off as the pencils are sharpened.

—Wm. Swallow, Brooklyn, N. Y.



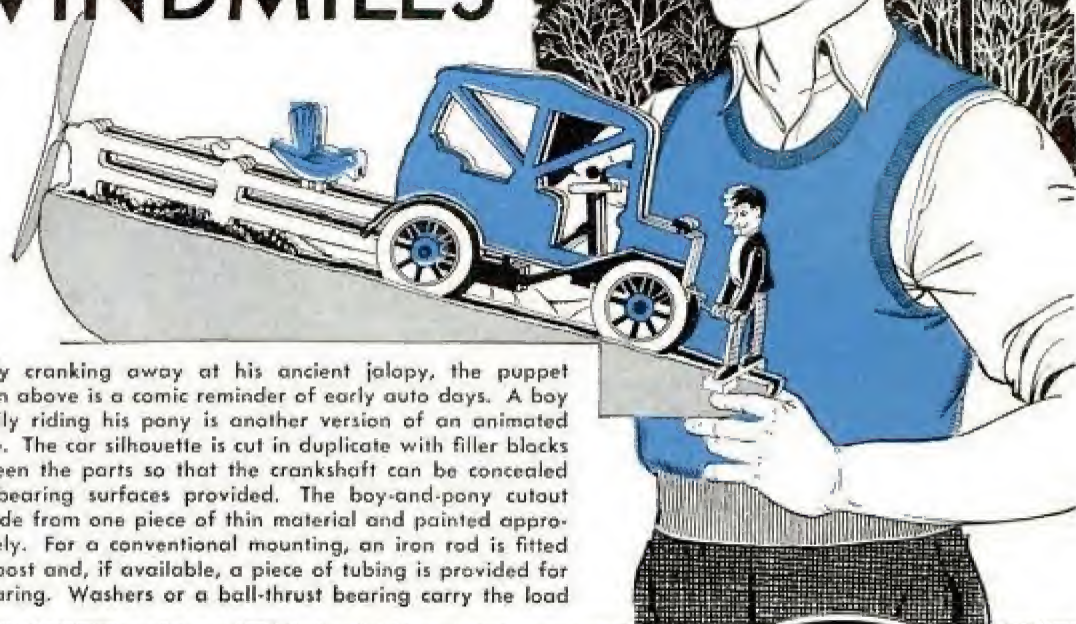
Coin Selector Snapped in Purse To Locate Change Quickly

Women shoppers who have difficulty in opening their coin purse and locating change when carrying a number of packages can avoid such trouble by fastening a coin selector inside their regular purse.

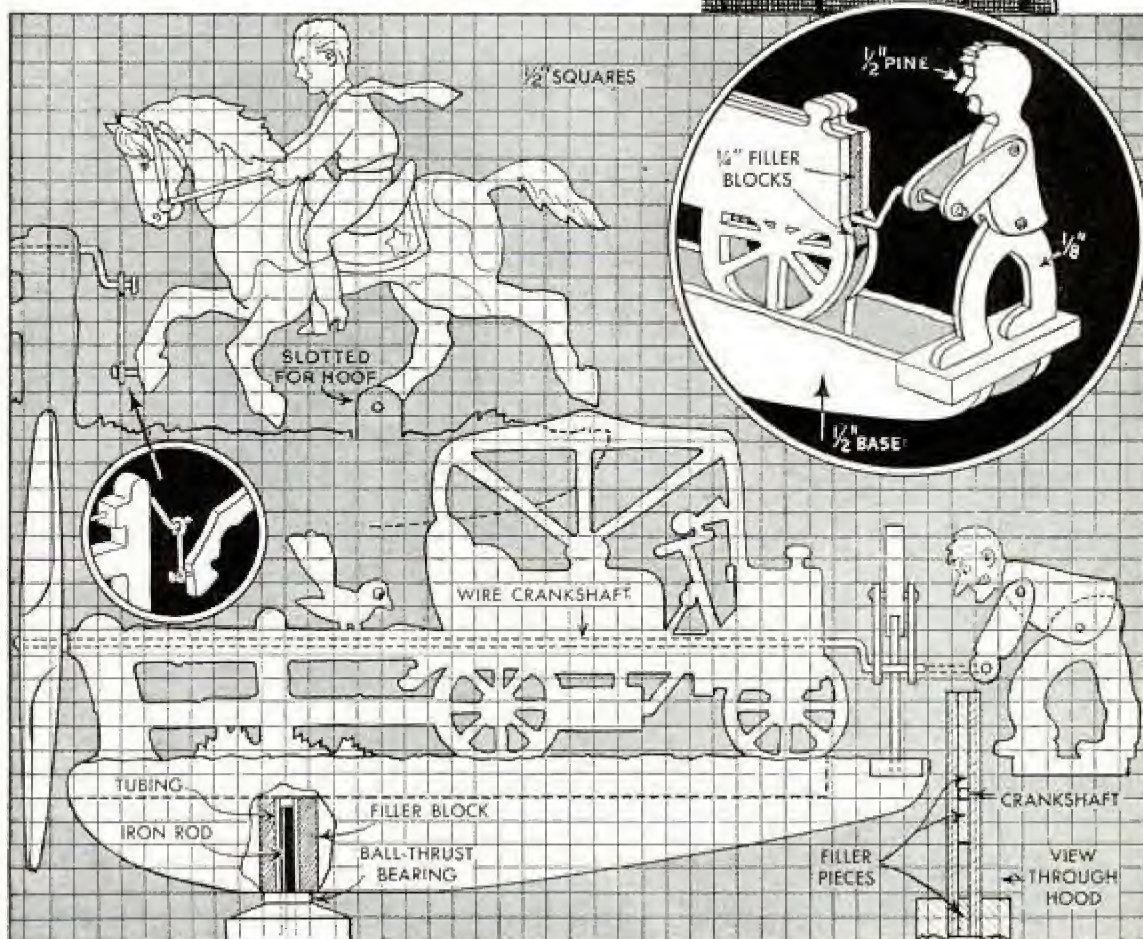


These selectors are generally available at ten-cent stores and they can be held in place by securing a dress snap at each corner of the case as shown. In this way, one selector will serve for a number of purses, as extra snaps can be sewed to other linings in a few minutes.

New actors on GARDEN WINDMILLS



Irrately cranking away at his ancient jalopy, the puppet shown above is a comic reminder of early auto days. A boy happily riding his pony is another version of an animated figure. The car silhouette is cut in duplicate with filler blocks between the parts so that the crankshaft can be concealed and bearing surfaces provided. The boy-and-pony cutout is made from one piece of thin material and painted appropriately. For a conventional mounting, an iron rod is fitted in a post and, if available, a piece of tubing is provided for a bearing. Washers or a ball-thrust bearing carry the load



Easy Way to Hold Paint Bucket While Painting Fence



You can avoid stooping to dip the brush in a bucket when painting a fence if it is hung from one of the pickets as shown. Just punch a hole in an empty can to take a wire hook and invert the can over the end of a picket as shown, hanging the paint bucket from the hook.

Rainproof Ventilating Frames For Porches and Bedrooms

Wooden frames covered with wire glass and attached to windows to project outward at an angle as shown will enable you to keep the windows of a bed room or glazed porch open for ventilation without any possibility of rain blowing inside. This idea is especially handy in homes where the members of the family are away during the day, as it permits some of the windows to be left open to keep the house from being hot and stuffy when they return. If



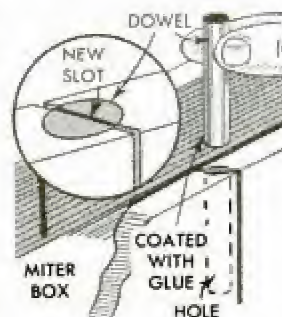
it is necessary to have the open windows completely covered to keep insects from entering, screens can be used in addition to the frames, or sides can be provided for the frames to close the window openings except at the bottoms, which are covered with screen wire.

Cementing Iron to Stone

If you have occasion to cement iron to stone or marble, the following mixture will be highly effective. It consists of plaster of paris, 30 parts, fine iron filings, 10 parts, and sal ammoniac $\frac{1}{2}$ part, mixed with vinegar to form a fluid paste.

Worn Slots in Miter Box Repaired With Hardwood Dowels

If the guide slots in a wooden miter box have become so worn that accurate work is no longer possible, you can repair them easily by using dowel pins set into holes bored vertically in the sides of the box. The holes

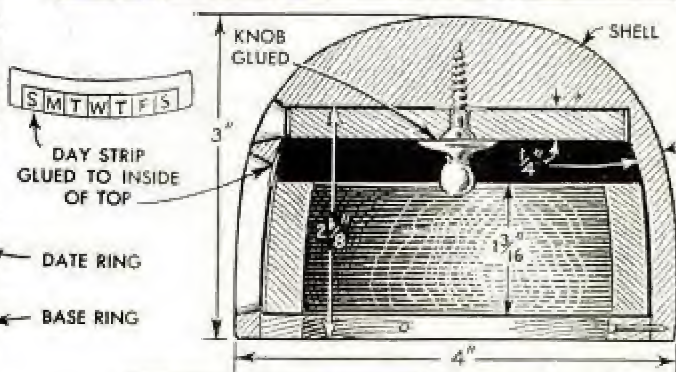
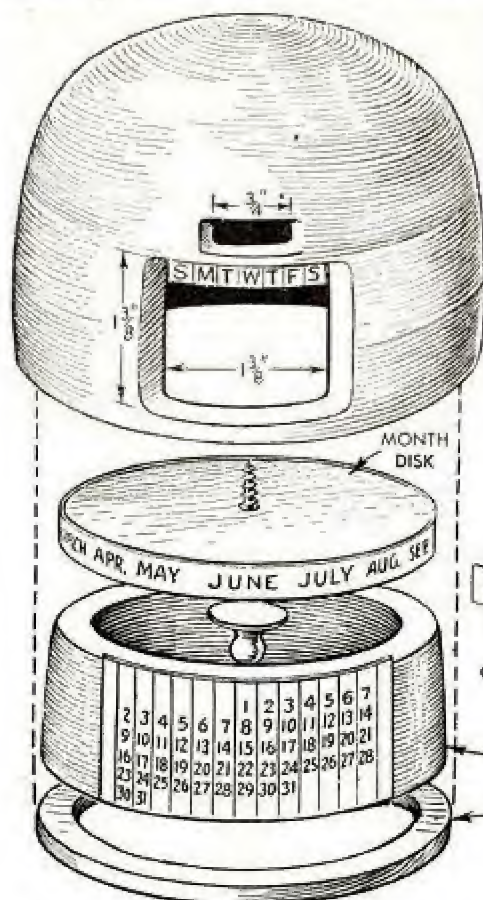


should bisect the original slots and should have a diameter a little over half the thickness of the stock in which they are drilled. The depth of the holes is optional, but should be at least half the depth of the original slots. If too shallow, the saw may cut inaccurately when working near the bottom. Cut dowels to match the hole depths, glue them in place and then cut new guide slots through them. If it is desired to repeat the repair later, it is easy to bore out the old dowels and replace them.

Hose Replaces Rubber Bearing Of Motorboat Shaft

As the outboard rubber bearings, often used on propeller shafts of motorboats, are now difficult to obtain, substitutes may be made from a piece of steam hose or other heavy-type rubber hose. This need not be a piece of new hose but should be in good condition. The water slots on the inside surface of the bearing may be cut out with a sharp knife kept wet with water while the actual cutting is being done. The fit and general design of the bearing should be approximately the same as that of the old one.—A. H. Vance, Ft. Lauderdale, Fla.

Perpetual Desk Calendar Housed in Small 'Igloo'

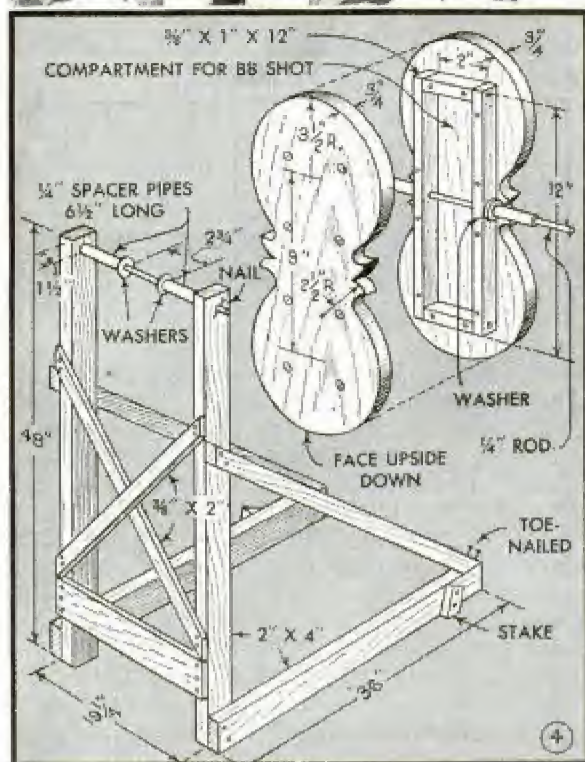
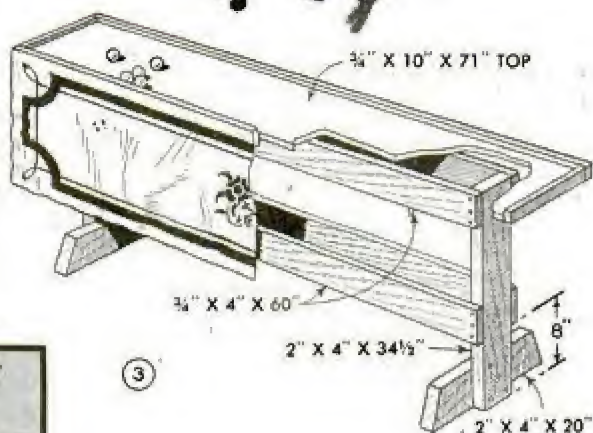
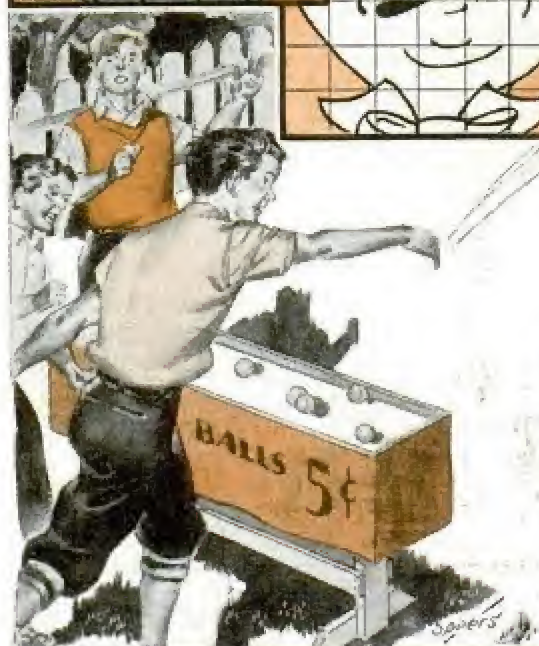
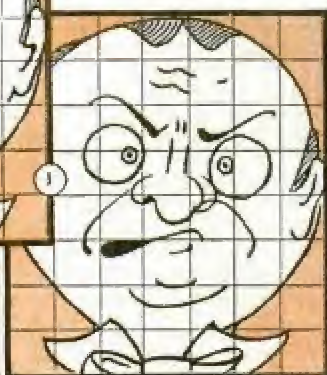


Turned and finished nicely in walnut or maple, this igloo-shaped perpetual calendar makes a handsome desk accessory which is both convenient and novel. The shell is turned from a block built up by gluing together five, $\frac{3}{4}$ -in. disks a little over 4 in. in diameter, one of the disks being of pine for attaching the work to the lathe faceplate. Hollow out the inside of the shell to a depth of $2\frac{1}{8}$ in. following the sectional view. Then shape the outside as far as you can, leaving a $\frac{1}{4}$ -in. wall, after which cut the work free of the pine block and finish off the rough spot by hand with fine sandpaper. To cut the windows in the shell, first drill a row of small holes completely around the openings to remove the waste and then finish by beveling and smoothing the edges with a sharp knife. Next, cut and pivot the month disk loosely in the top of the shell with a flat-head screw, placing a thin washer between the disk and shell for clearance, and glue a suitable knob over the screw head.

This leaves the date ring which is held inside the shell by a base ring. Turning the outside of the date ring after you have completed the inside, requires the use of a wooden chuck, tapered slightly, over

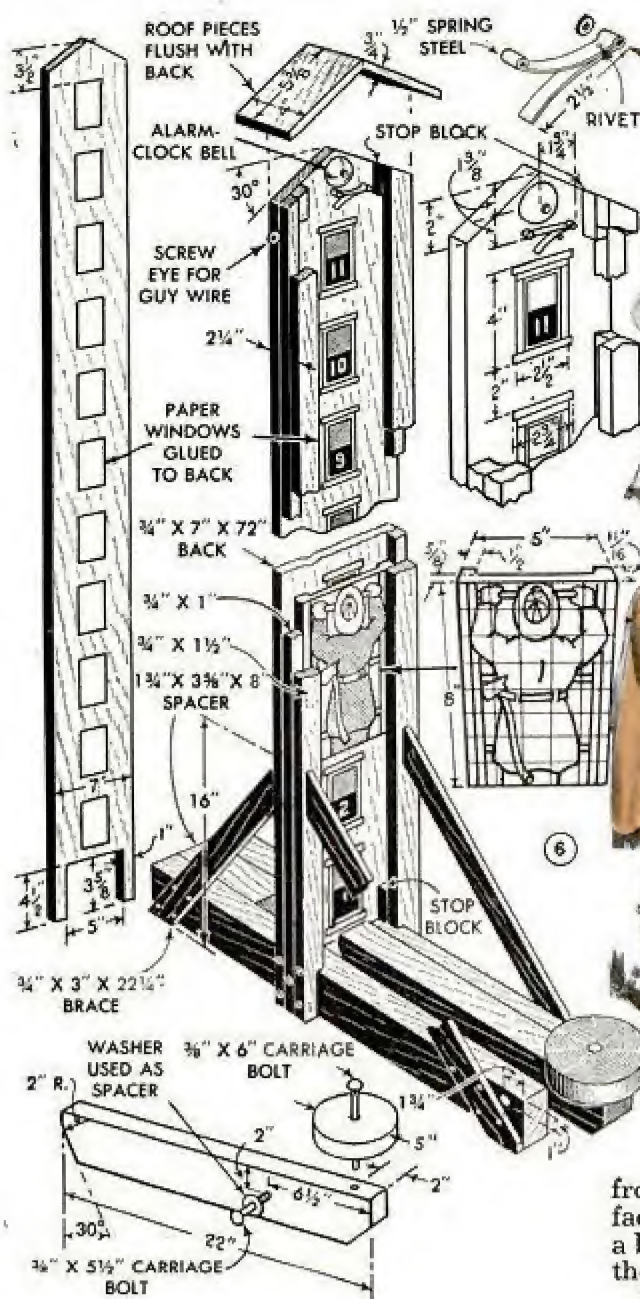
JAN.			FEB.			MARCH			APRIL			
MAY			JUNE			JULY			AUG.			
SEPT.			OCT.			NOV.			DEC.			
			S	M	T	W	T	F	S			
						1	2	3	4	5	6	7
2	3	4	5	6	7	8	9	10	11	12	13	14
9	10	11	12	13	14	15	16	17	18	19	20	21
16	17	18	19	20	21	22	23	24	25	26	27	28
23	24	25	26	27	28	29	30	31				
30	31											

which the ring can be pressed firmly to hold it for turning. The date ring is set on the base ring and is turned by bracing the thumb, first and little fingers against the inside of the shell. The calendar is set by turning the month disk until the proper month appears centered in the window and then the date disk is moved to bring the first of the month under the day on which the first of the month comes. The calendar is printed full size in the drawing so that it can be cut out and pasted in the positions indicated. Note that the date card extends about $\frac{1}{8}$ in. above the ring to pass behind the day strip.



As no carnival would be complete without an "attraction" that tests the skill in throwing a baseball, we start off with the game of "Make Old Sourpuss Smile." A piece of canvas is stretched between poles, as shown in Fig. 2, and a hole about 10 in. in diameter is cut through the canvas with the center just 51 in. above the ground. Behind this opening is placed a rack with the double

in the Backyard



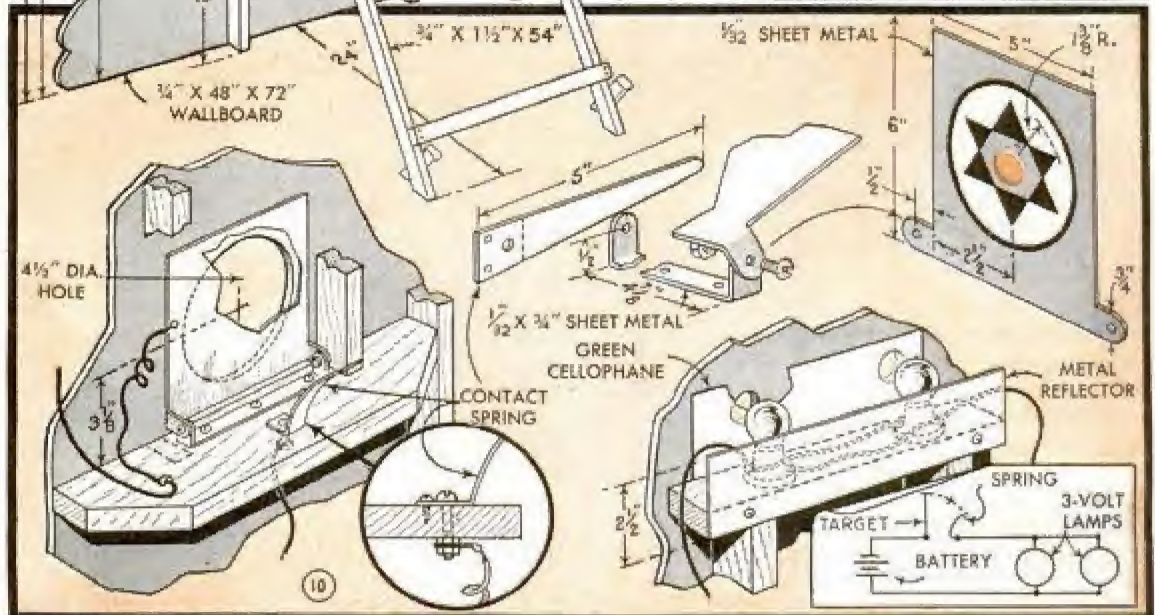
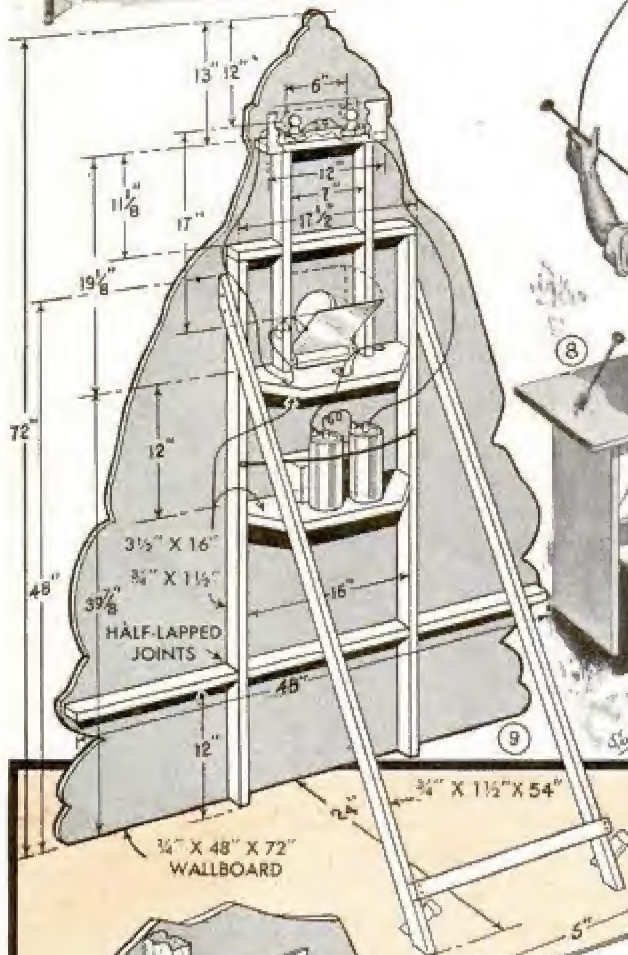
head as detailed in Fig. 4. The device is arranged so that if the ball strikes the scowling face it will swing over and the smiling face will appear behind the opening. The next time it is hit the faces will be reversed again.

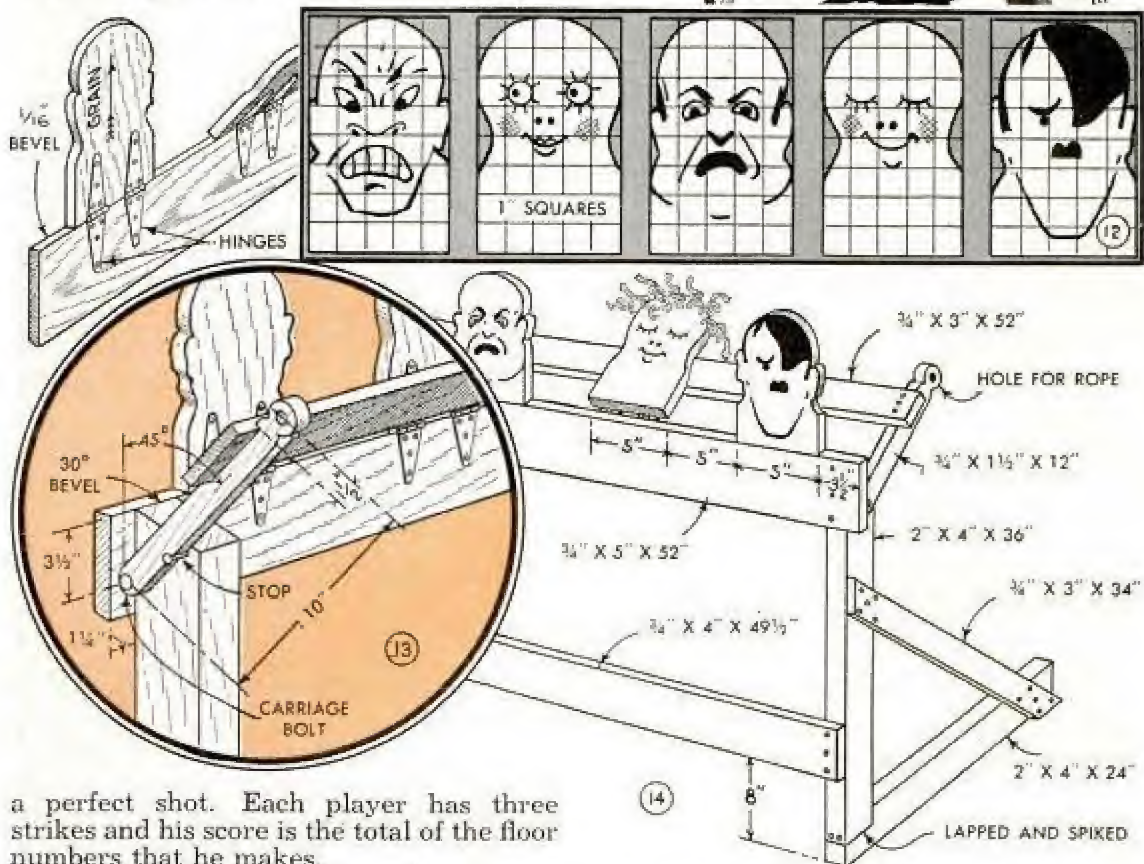
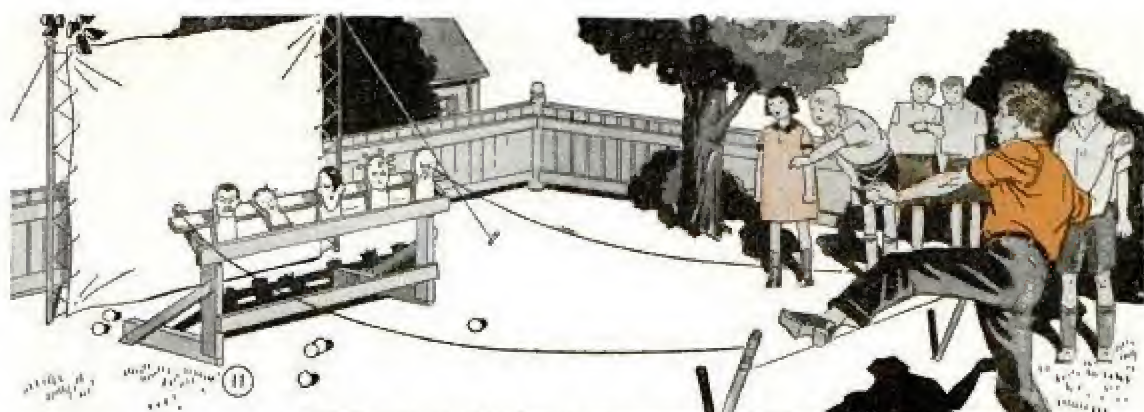
The swinging unit consists of two scroll-sawed pieces and a closed frame to contain BB shot, which serves as a weight to keep the unit in a vertical position, the shot rolling from end to end when a head is hit and turned over. The frame is assembled and



screwed to the back of one of the shaped head pieces, the other piece being screwed to the frame from the front, to enclose it completely. Painting faces on the heads as in Fig. 1 and making a ball rack as indicated in Fig. 3, completes the job.

The Climbing Fireman shown in Fig. 5 is the answer to boys who want to show their strength. It consists of a vertical track on which a block, painted to represent a fireman, is made to climb by striking a disk on the end of a treadle with a croquet mallet. This causes the inner end of the treadle to drive the figure up a back board or track, as shown in Fig. 5. Windows, to simulate a skyscraper, are painted or pasted on the board at intervals to indicate how many floors the player has made the fireman climb. If the player succeeds in driving the fireman to the top, a bell rings, indicating





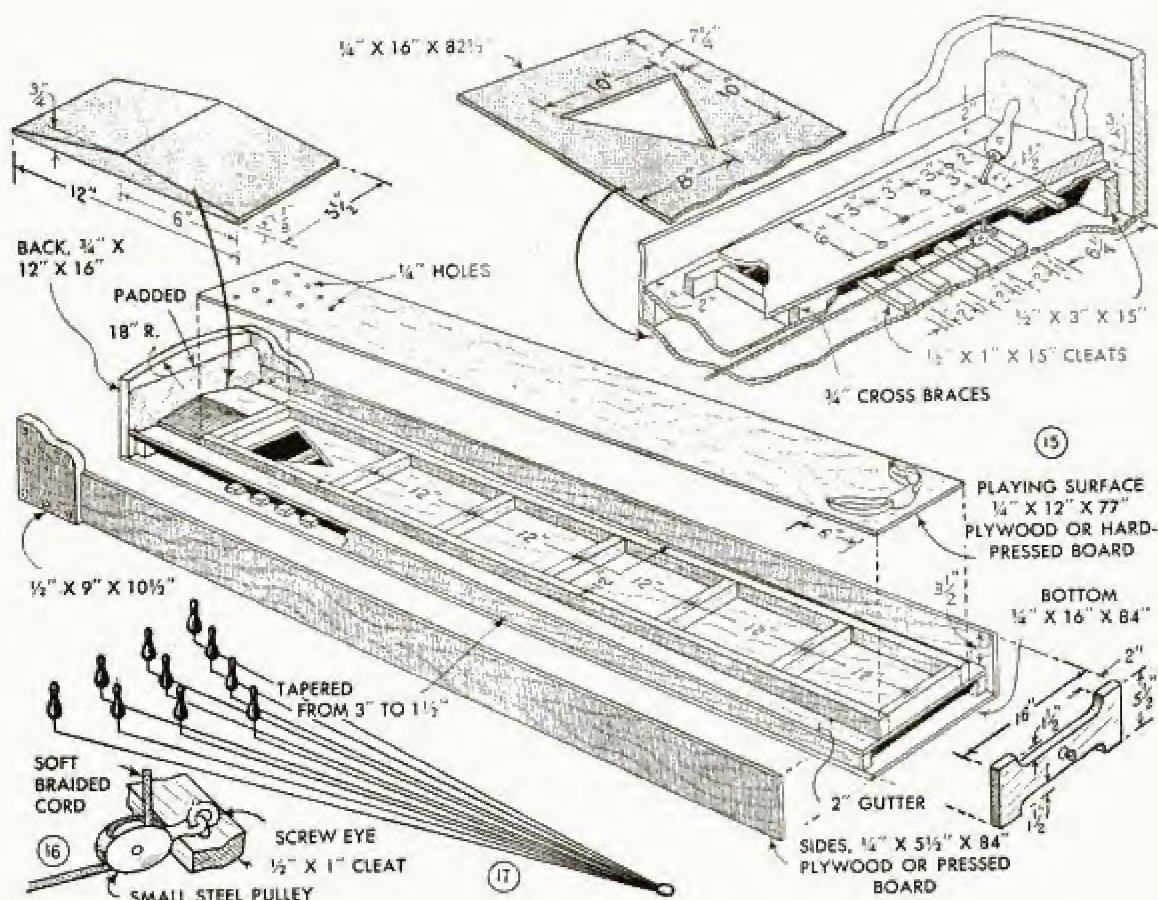
a perfect shot. Each player has three strikes and his score is the total of the floor numbers that he makes.

The treadle is pivoted to a frame consisting of two strong pieces, either solid or built-up stock, which are nailed together with a spacer at the back. The disk or strike plate is made of hardwood and is bolted to the treadle with the grain of the wood running at right angles to the treadle. The back board, shown in Fig. 6, is cut out at the bottom to straddle the treadle frame, which is screwed to it and braced diagonally. Guide strips at the edges form grooves in which the fireman slides, and stop blocks at the top check the figure at this point. The top of the back board is finished off with two pieces to simulate a roof. The figure is recessed at the back to reduce friction and to avoid scraping loose the paper windows. In use, the device is supported further by stakes driven along-

side the treadle frame and by four guy wires.

The Green-Eyed-Buddha Target shown in Fig. 8 has a special appeal for young archers. A medal on the chest has to be hit with a suction-cup arrow. Then the eyes light up green and remain lighted until the target is reset. The target consists of a large figure cut out of wallboard as shown in Fig. 7. Fig. 9 shows a rear view of the target and the wood framework to which the wallboard figure is tacked. Three shelves are provided for batteries, target switch and miniature lamps. Two large 1½-volt dry cells are connected in series to provide current for the 3-volt lamps.

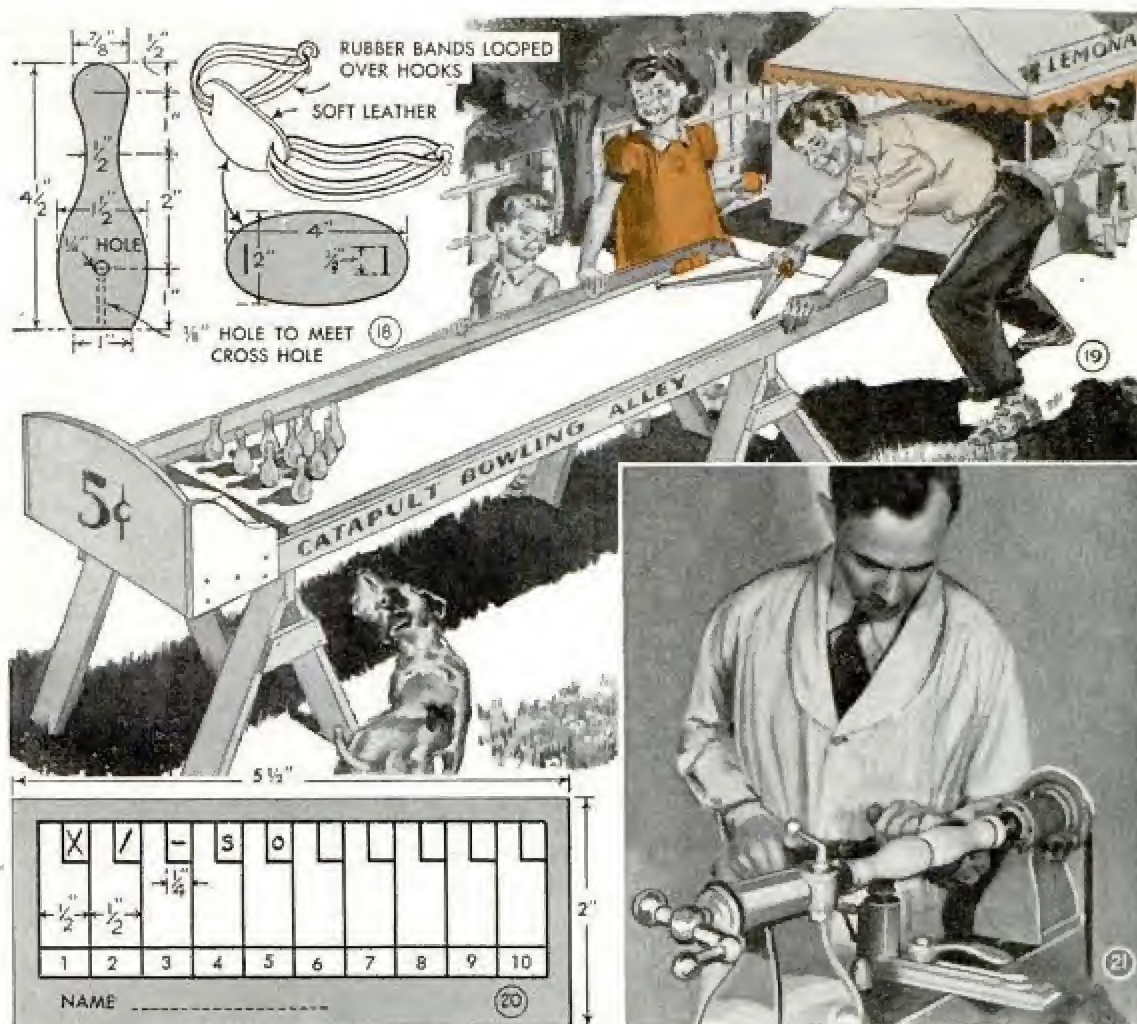
The medal is cut to the shape indicated in Fig. 10. Projections on the lower cor-



ners are bent so that they fit an iron bracket, to which the medal is pivoted loosely enough so that a slight blow will cause it to swing back and make contact with a brass strip. Two wood screws and a machine screw are used to mount the contact strip on a shelf behind the target opening. An additional machine screw or binding post is used to anchor a "pig-tail" connector of flexible wire, which is soldered to the medal. Two miniature sockets for the lamps are screwed to a shelf directly behind the eye holes, which are covered with green Cellophane. The wiring diagram is shown in the lower right-hand detail of Fig. 10.

Man Overboard as shown in Figs. 11 to 14, is a riot of fun for everyone. It is really the old "Doll Rack" in a new form and with a reset arrangement operated by simply pulling a cord. The object of the game is to see how many figures can be knocked over with five baseballs. A canvas back-stop is arranged to catch the balls that go wild. Fig. 14 details the rack and Fig. 13 shows the reset arrangement. The designs for the various heads are shown in Fig. 12, and the method of hinging them to a base is shown in the detail at the left. The features are painted on the pieces after they have been band-sawed to shape.

The Catapult Bowling Alley will furnish fun and amusement galore, and is large enough to play a real game involving considerable skill and technique. The game is played essentially the same as on a regulation bowling alley except that the ball is catapulted as shown in Fig. 19 instead of being rolled, and the pins are reset by pulling cords. Scoring is the same as regular bowling, a game consisting of ten frames with only two balls played for each frame. If all the pins are knocked down by the first ball, the score is called a strike and the second ball is not used. A strike is indicated by "X" on your score card, Fig. 20. If some of the pins remain standing, the second ball is played. Should this ball knock down the remaining pins, you have scored a spare, indicated by "/". A strike entitles the player to a score of 10 points plus what is made on the next two balls bowled. A spare entitles the player to 10 points plus the score made on the next ball played. If neither a strike nor a spare is scored in the frame, the total number of pins knocked down are counted as your score. Should a strike be made in the 10th frame, two additional balls are played immediately and the total score determined. A spare entitles the player to one additional ball. Strikes, spares and blows



(neither strike nor spare) are indicated on the score card immediately, but the number of points cannot be indicated until the additional balls have been played in the case of spares and strikes. The score for each frame consists of the points made in that frame plus those made in the previous frame and your final score is the amount shown at the end of the 10th frame.

Fig. 15 shows how the alley is constructed. The ends, spacers and cleats are made of solid wood, and the other parts of plywood or hard-pressed wood. A pad at the end of the alley is used to absorb the force of the ball. A sloping block at the back diverts the ball to one of the gutters, these being slanted toward the front so that the ball will be returned to the player. A 1½-in. billiard ball is used to play the game. Fig. 18 shows a detail of a pin and the catapult sling. Heavy rubber bands are looped through the leather ball holder and secured to two large screw eyes that have been opened just enough to admit the rubber bands. The pins are turned in pairs as in Fig. 21.

Figs. 16 and 17 show the arrangement of

the cords and a detail of the small awning pulleys that are used to set the pins from the front of the alley. The cords are strung through holes in the bottoms of the pins, and drawn out through the intersecting side holes for knotting. The cords pass through the holes on the playing surface and through a triangular opening in the gutter floor under the playing surface. Then they are run through the pulleys directly under the holes and are brought out to the front of the alley where they are all tied to a ring. When the pins are all set up there is a slack of about 8 in. in the cords to permit the pins to be knocked down. Soft braided cotton cord about 3/32 in. in diameter is used.

Replacing Motorcycle Chain

When the rear chain of a motorcycle must be removed for cleaning and greasing, it can be replaced on the front sprocket more easily if a length of old chain is attached to the one being removed. This is left hanging around the front sprocket, and used to pull the regular chain into place.

Baby Can't Upset a High Chair Hooked to Baseboard



After a baby gets old enough to stand up in its high chair and rock it so there is danger of tipping it over, just hook the chair to the baseboard. Screen-door hooks screwed into the baseboard to engage screw eyes in the rear chair legs will solve the problem, and take only a second to hook or unhook whenever necessary.

—Helen Thompson, San Francisco, Calif.

Paper Keeps Cork From Sticking In Bottles of Sugary Liquids



Corks frequently stick in bottles that contain sugary liquids. This annoyance can be prevented with a small piece of waxed paper smoothed to the cork before inserting it. You will find that all of

the contents of the bottle may be used without a sugary seal forming on the cork.

Softening Peanut Butter in Jar

When a jar of peanut butter is first opened, most of its oil is found on top, while the butter near the bottom is dry or stiff. Attempts to stir or re-mix it are not only messy, but usually result in splashing oil on your clothes or tablecloth. An easy way to overcome this problem is to invert the unopened jar under the faucet and gradually turn on the hot water. Leave it

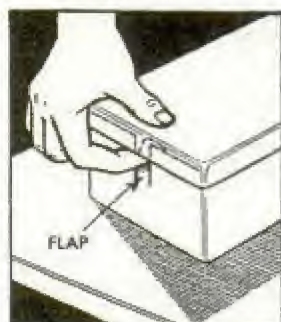
there for about 10 minutes with boiling hot water running down the sides of the jar. An alternate method, in the absence of running hot water, is to boil the inverted jar in any tall pot. Do not plunge the cold jar into boiling water, as it may shatter. The heat will re-soften peanut butter and cause the oil to rise and permeate the entire contents. Turn the screw cap down tightly and put the jar upside down between servings.—A. Vena, New York City.

Tack Holder From Pipe Cleaner

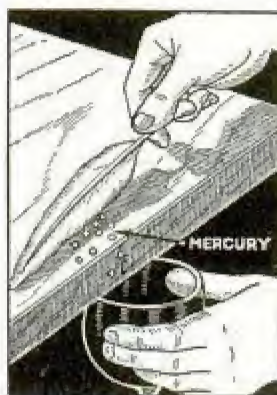
A handy holder for driving tacks and small nails can be made from a pipe cleaner. This is bent back for a distance of about 1 in. from the end to form a loop which holds the tack. After the latter has been started, the cleaner is removed by pushing it forward.

Flap Cut in End of Cardboard Box Aids in Removing Lid

If you use cardboard boxes as file cases for photo negatives, magazine clippings or other papers and are often annoyed by the difficulty of removing the lids when in a hurry, cut one end of each box to form small flaps as shown. These do not mar the appearance of the cases, yet they provide a simple means of getting a finger under the lids to remove them quickly.



Feather Serves as Handy Brush To Recover Spilled Mercury

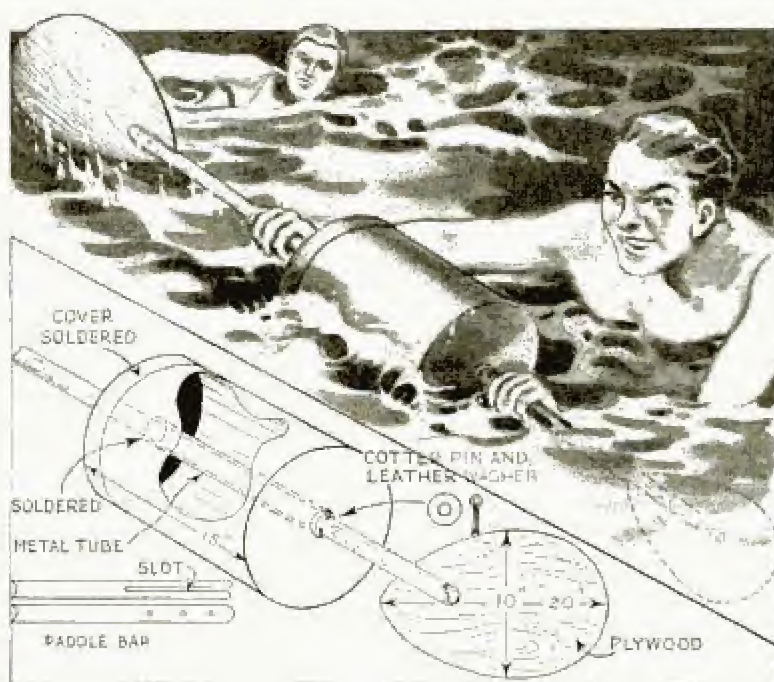


Next time you are working with mercury in a laboratory or shop and accidentally spill some of it on the bench, try recovering it with a large feather instead of a brush. The flexibility and fine edges of most feathers make them ideal as improvised brushes

for gathering the drops and getting them back into a container.

Fun at the Beach With These Paddle Floats

Anyone unable to swim can still enjoy this sport safely by using a paddle float like the one shown. It is operated by dipping the paddles into the water much like paddling a canoe. The float is made by soldering a tube or pipe into holes in the bottom and cover of a large can about 15 in. long and 10 in. in diameter. This permits a paddle bar to be inserted through the can and still keep it watertight. The paddle assembly consists of a wooden bar about 1 in. in diameter and 7 ft. long which is slotted at the ends to receive the paddles, which are made of $\frac{1}{4}$ -in. plywood and coated with spar varnish.



Pointers to Help Grow Garden Vegetables Successfully

Growing a small vegetable garden is not difficult if it is planned carefully and a few important things are kept in mind. First, select a well-drained plot of good soil. Spade or plow the ground deeply, at least 8 or 10 in. This loosens the subsoil so that it will hold moisture and the tiny plant roots can penetrate it. Work a good fertilizer into the soil as you prepare the seed beds. If you do not wish to fertilize all the ground in the plot, fair success can be had and fertilizer saved by working it into the soil only under the seed rows at the time of sowing, or under seedlings when transplanting them. Remember, however, that due to climatic and soil conditions, some localities are unsuited for growing certain types of vegetables. Inquire from those who have grown gardens in your neighborhood as to the kinds of vegetables to plant. In general, you can follow the instructions on the seed packets regarding planting time and culture. When the instructions state that the seeds can be sown as soon as the ground can be worked in the spring, do just that. Vegetables of this type will not be affected by light frosts and must be planted early because they either require a long time to reach maturity, or grow best during cool weather, making it necessary that they have time to reach maturity before hot, dry weather starts. When planting seeds, follow the instructions faithfully as to the depth they are to be

covered, and firm the soil on them with the flat side of the hoe. Some seeds can be spaced in the trench the distance they are to grow, while others must be sown at least twice as thick as they are to grow and must be thinned after the seedlings are $\frac{1}{2}$ in. or so in height. Be sure to thin the seedlings to the recommended spacing, otherwise they will grow spindly and not develop. If you have been unable to grow peas successfully, make the seed trench 4 to 6 in. deep, cover the seeds to a depth of $1\frac{1}{2}$ or 2 in. and gradually fill the remaining trench with dirt against the stems of the seedlings as they grow. This method provides good coverage over the roots which helps to prevent them from drying out. A good way to force vegetables that must grow rapidly, such as radishes, is to use the liquid from sheep manure that has been soaked in water for a couple of days. Just dampen the soil under the seed trench with the liquid, then cover with a $\frac{1}{2}$ -in. layer of dirt in which the seed is planted. If tomato seedlings are long and spindly when transplanted, set them deeply in the ground, up to the second pair of leaves is not too deep. This will enable the plants to produce an unusually strong root system that will help them during dry weather. It is a good idea to stake all tomatoes and peas regardless of the type. This keeps the plants from falling over on the ground where they are more susceptible to disease.

Food Bag Shields Camera Case Against Rain or Snow



Slipped over your carryall camera case when you find it necessary to take it out in bad weather, a Pliofilm or oiled-silk food bag will protect the leather from water. Such waterproof bags are available in many sizes and shapes. If it is necessary to cut slits in the material to accommodate the camera-case straps, the openings should be reinforced with cellulose tape.

Identifying Mark Made on Print Without Damaging Negative

A particular point in a photograph, such as a window in a house or a person in a group, can be marked with an arrow while making the print without altering the negative. Just cut a small arrow from opaque paper and lay it on the negative before making the print.

—C. N. Crottsenburg, El Cajon, Calif.

Thumbscrew in Tripod Socket Holds Camera in Case



bottom of the case and into the camera. A washer, a little larger than the screw hole

To hold your camera in an ever-ready case so that it cannot fall out if the strap should get loose and the case should be inverted accidentally, you can use a $\frac{1}{4}$ -20 thumbscrew. This goes through the tripod-mounting hole in the

in the case, is soldered to the shank of the screw, and the latter is cut off so that the washer will come snugly against the case when the screw is turned down.

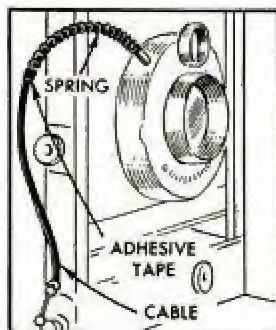
Nicks in Crayon Mark on Bottle Show Age of Developer

When he mixes up a fresh bottle of developer, one photographer makes a long crayon mark on the side of the bottle. Each time the solution is used, he makes a scratch through the mark with his thumbnail. Thus, he always knows how

many rolls have been developed, and can discard the solution at the proper time.



Small Spring on Cable Release Keeps It From Kinking



Placed on a camera cable release and fastened with tape, a small coil spring keeps the release from kinking. The spring is especially useful in keeping the release from bending when a heavy self-timer is used.

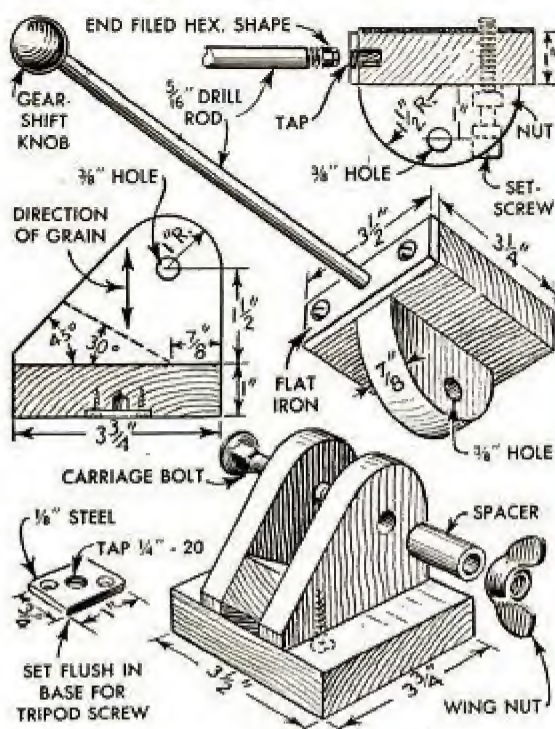
Emergency Ferrotypes-Tin Polish

While it is not recommended for regular use, waxed paper can be used in an emergency to polish ferrotypes tins. Crumple a piece of the waxed paper and rub it thoroughly over the entire tin, as shown, then polish with a soft cloth. Heavily waxed paper will be found to give the best results.

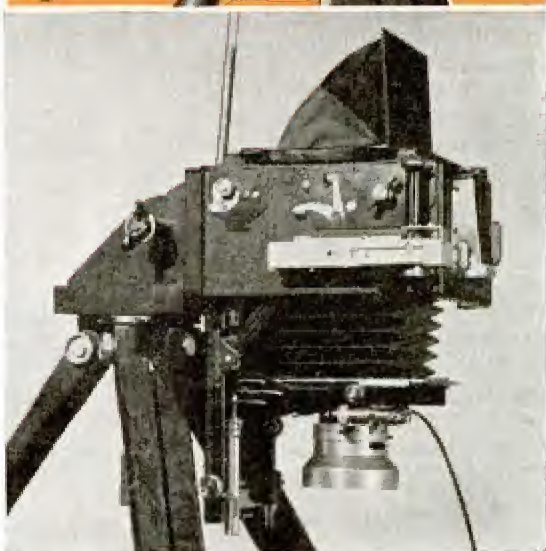
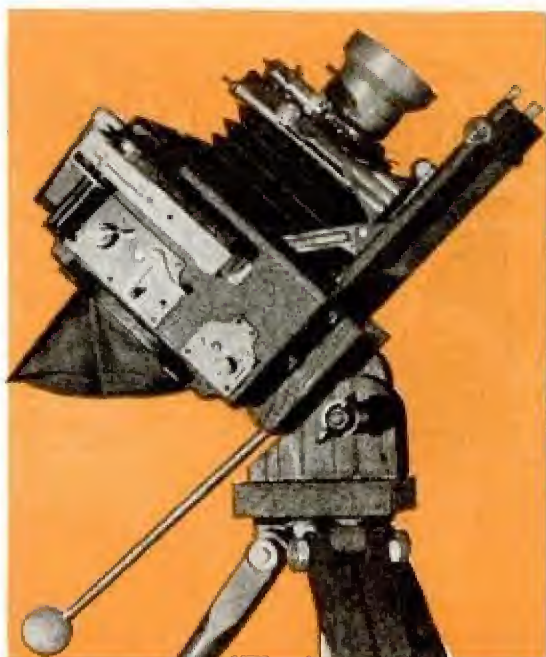


☛ A brush of the type used to clean coffee percolators is excellent for cleaning the necks of darkroom funnels, in which deposits are likely to collect.

Tilting Tripod Head Holds Your Camera Firmly



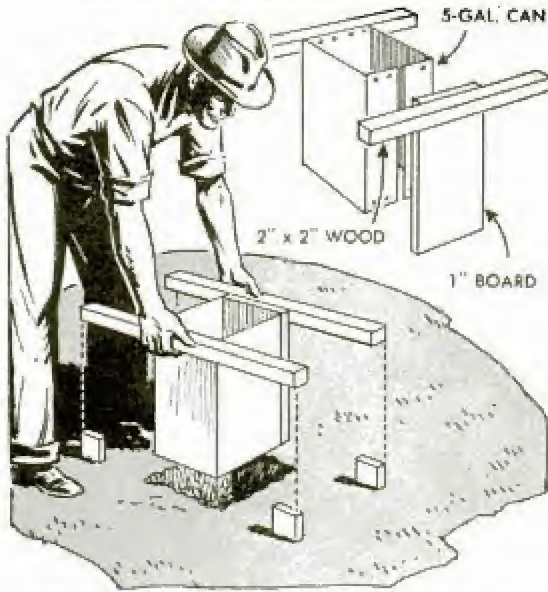
This homemade tilting tripod head enables the camera to be swung up to an angle of 45 degrees as shown in the upper photo or to any angle between this position and the vertical position shown in the lower photo. For panorama views it can be swung around horizontally after the tripod screw has been loosened. The cost of such a tilting top is practically nothing as you can make one from scrap stock plus a few bolts and screws. Three vertical friction blocks, two on the lower part of the head to straddle one on the upper part, are locked firmly together to hold the camera in any position when you tighten the thumbnut. Details above show all the parts, their sizes and the method of assembling them. A metal plate, $\frac{1}{8}$ in. thick, is fitted in a recess to come flush with the underside of the head. It is drilled and tapped to take the $\frac{1}{4}$ -20 thumbscrew of the tripod, and is fastened in place securely with flat-head screws. A $\frac{1}{4}$ -20 setscrew having a hexagon-shaped recess instead of a screw slot, is provided in the upper part of the head for attachment of the camera. The setscrew threads through a nut, which is set in a square hole chiseled in the center friction block. Also, the screw hole in the block is counterbored to take the head of the screw when the latter is driven down so that it will not project beyond the curved edge of the block, which would interfere with its movement. A piece of drill rod is used for a handle to manipulate the head.



An auto gearshift lever is fitted to one end and the other end is threaded to fit a metal strip as shown. Part of the threaded end is filed down to hexagon shape and hardened so that the handle can be used to turn the setscrew. The friction blocks must fit together rather snugly even when the thumbscrew to lock them is released. Their contacting surfaces should not be sanded very smooth and no wax or polish should be applied here since friction is desired. A spacer cut from a length of tubing fits over the bolt and is inserted into the hole of the center friction block. The spacer should be just a trifle less in length than the thickness of the block.

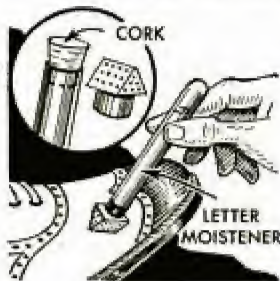
—G. F. Bateman, Denver, Colo.

Discarded Oilcan Used as Form For Top of Concrete Pillar



Where the ends of concrete pillars for foundation and center support posts extend above ground level, handy forms often can be improvised from 5-gal. oilcans. These are adapted by removing both ends and then slitting each one down the side. The cut sides are bradded to blocks of wood, after which supporting crosspieces are attached as shown, to provide a means of adjusting the forms to proper height with wood blocks or stakes driven into the ground. If inside surfaces of the cans are well oiled before pouring the concrete, the forms will separate from the concrete easily as the brads can be pulled through the tin. In loose soil, it may be advisable to use additional cans as the hole is dug to prevent cave-ins.—A. L. Mills, Chicago.

Shoe Cleaner Applied Easily With Letter Moistener



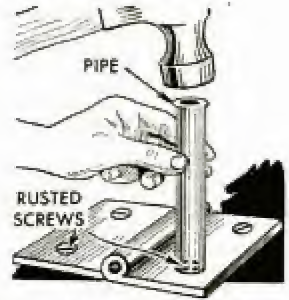
When cleaning sport shoes, especially those of two or more colors, put the cleaning liquid in a letter moistener of the type shown and use it as an applicator. You can do the

job without soiling the hands, and without getting the liquid on adjoining colors or the soles. When finished, remove the sponge from the moistener, clean it in water and put a cork in the moistener tube in place of the sponge until needed again. The moistener is espe-

cially handy if you are traveling, as it can be carried safely and conveniently in a bag or suitcase where it is always at hand for instant use.

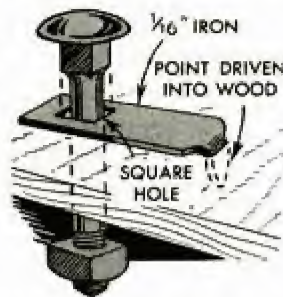
Screws in Door Hinges Loosened By Simple Pipe Tool

While dismantling old cars, one mechanic found it extremely difficult to loosen the screws of heavy door hinges due to rust around the screw heads. To break these loose for removal of the hinges without damage, he used a short length of pipe as a tool. This was merely set over the screws and given several sharp blows with a hammer, which proved very effective in speeding the job. The inside diameter of the piece of pipe used, of course, should be just slightly larger than that of the screw heads.



"Lock" Keeps Bolt From Turning

If you have experienced the annoyance of having a rusty carriage bolt turn while trying to unscrew the nut, the next time you bolt wood parts together use this simple locking shim, which is merely a piece of light flat iron. Square a hole through the shim near one end to a size that will slip over the squared portion of the bolt head. Then file a point on the opposite end to the shape indicated and bend it at right angles. Before you drive the bolt home, drive the pointed end of the locking shim into the wood.



Salt Holders for Lunch Boxes

You can avoid the annoyance of spilled salt and pepper or sugar in a picnic or school lunch box by using large capsules as containers. These capsules are obtainable at most drug stores, and are very handy when a lunch box contains fresh tomatoes, salads, etc., that require seasoning immediately before eating. Handle the capsules carefully and they can be used repeatedly.



SHOP NOTES

Keep Your Lathe Clean



It's easy to spot a good machinist by the way he takes care of his equipment. Clean and properly oiled lathes last indefinitely, afford ease of operation, enable a good man to turn highly accurate work and help to speed up production. Photos and information provided by courtesy of South Bend Lathe Works



YOUR lathe is of value for precision work only as long as it retains its high degree of accuracy. To keep it in this condition indefinitely, cleanliness at all times is of utmost importance. Scale, grit and fine chips that mix with the cutting oil form a dirty sludge that sticks to the ways and dovetails, gets under the tailstock and saddle and into the spindle taper, forming an abrasive coating that causes excessive wear. Besides reducing the serviceable life of a lathe, dirt and chips impair greatly its ease of operation and result in a definite decrease of production both on account of slowness and because of the percentage of work that is rejected for being inaccurate. Besides removing chips that pile up constantly while turning, little extra effort is required to apply a daily, systematic routine of cleaning all the parts, including those that are apt to be overlooked.

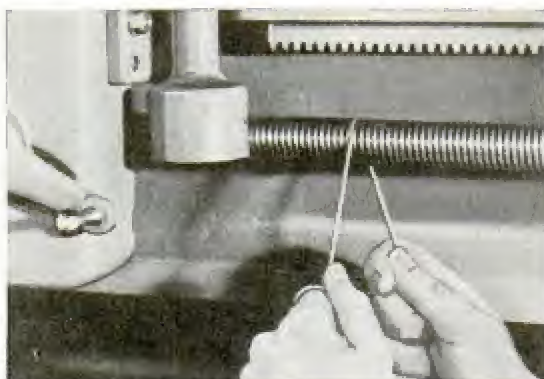
Handling steel shavings: All steel shavings are razor sharp and must be handled with care to avoid cutting the hands. A pair of tongs, pliers, a hook or magnet (for



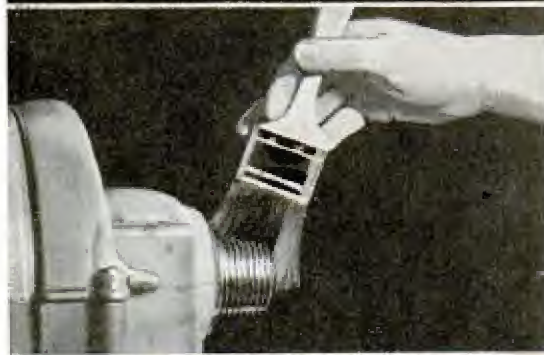
① STIFF-BRISTLED PAINTBRUSH REMOVES LOOSE DIRT AND SMALL CHIPS FROM LATHE CARRIAGE AND BED



② CLEAN, OILED CLOTH SUPPLEMENTS BRUSHING TO WIPE UP THE LAST TRACES OF DUST AND GRIT



③ HOW TO CLEAN DIRT FROM THREADS OF A LEAD SCREW BY USING A CORD OF SUITABLE THICKNESS



④ BRUSH ALL DIRT FROM THREADS ON SPINDLE AND OIL THEM BEFORE MOUNTING A CHUCK OR FACEPLATE

iron and steel), are useful in pulling shavings away from the lathe, while a pile on the floor can be handled conveniently with a coal fork or scoop when loading it into a box, truck or wheelbarrow.

Brushing and wiping: After removing a pile of chips from the lathe, a large bench brush is handy to clean loose chips from the carriage and bed, after which a stiff-bristled paintbrush will be found handy for brushing away loose dirt and chips, as shown in Fig. 1. The carriage is moved by turning the apron hand wheel in order to get at all parts of the bed. When finished brushing, wipe the surfaces with a clean oiled cloth, Fig. 2. However, when using a cloth in this way the lathe should not be running, as the cloth may become tangled with the work or other moving parts and be a source of danger to the operator. Also, do not use compressed air when cleaning a lathe, as it tends to force small particles between bearing surfaces and into oil holes, where they are difficult to remove and may cause considerable damage. Also, compressed air may blow chips and dirt into the eyes of the operator or other workmen.

Kerosene and other cleaning agents: In addition to such daily care, a weekly cleaning with kerosene will help to remove sticky oil. Any caustic cleaner should be avoided as it might cause the machined

surfaces to rust and will affect the enameled parts also. Carbon tetrachloride, which is nonflammable, is a good cleaning agent, but naphtha, gasoline and other inflammable agents should not be used. Any good metal polish and possibly some fine steel wool are good for polishing tarnished and slightly rusty spots.

Cleaning threads: The threads of a lead screw are cleaned easily with a cord of suitable size, which is run in the thread groove, the cord being pulled back and forth while the screw is turning as shown in Fig. 3. Or, you can use a stiff scrubbing brush and kerosene to do the job. Before mounting a chuck or faceplate always clean and oil the threads and shoulder of the lathe spindle as in Fig. 4, as a small chip or particle of dirt can prevent the chuck from running true and may even cause it to stick on the spindle nose. Similarly, the threads in the chuck must be kept free from chips and dirt. When the chuck is not in use, keep the hole plugged with a clean cloth. Before mounting it on the lathe, brush out the threads with a stiff brush. To dislodge chips in the threads you may need a bent wire cleaner having the ends filed to a V-shape to fit the



⑤ THREADS IN CHUCK BACK CAN BE SCRAPPED CLEAN WITH A BENT WIRE FILED AT THE ENDS TO A V-SHAPE



⑥ A BOTTLE BRUSH IS CONVENIENT FOR REMOVING THE DIRT AND CHIPS FROM TAPERED HOLES

threads as shown in Fig. 5. If the chuck still binds when screwing it on the spindle nose, examine the threads carefully under a suitable light as a small chip is likely to be found imbedded in the thread.

Spindle tapers: Unless free from burrs and perfectly clean, tapers will not fit together perfectly. A small chip not only prevents a good hold but will throw a taper out of true. To clean the tapered holes in the headstock and tailstock spindles, wrap a clean cloth on a stick or use a bottle brush as in Fig. 6. An inexperienced operator should not have the lathe running while cleaning the headstock spindle, and his fingers should never be inserted into the taper of a turning spindle. Lathe centers and tapered shanks of drill chucks are wiped clean as in Fig. 7 before inserting them into a spindle taper. When these do not run true the taper may not be clean. Dirt or chips between a collet sleeve and the taper in a spindle may cause the collet to run out of true several thousandths of an inch.

Compound rest and toolpost assembly: Before setting up a new job or readjusting the tool, the compound rest and toolpost assembly should be cleaned, as a small chip under the toolpost ring or tool holder may interfere with solid support of the tool, which is necessary for taking a smooth cut. Also a chip lodged beneath the cutter bit may cause it to be broken. Chips and dirt that work into the dovetail bearing surfaces may make them bind and become difficult to operate, and if chips should get between the dovetail bearing surfaces or between the base and swiv-



⑦ WIPING CLEAN THE TAPER SHANK OF A DRILL CHUCK BEFORE MOUNTING IT IN THE SPINDLE TAPER



⑧ APRON OIL RESERVOIR IS DRAINED, FLUSHED WITH KEROSENE AND THEN REFILLED WITH SUITABLE OIL



⑨ A SUCTION PUMP IS USED TO DRAIN THE OLD OIL FROM THE HEADSTOCK OIL RESERVOIRS



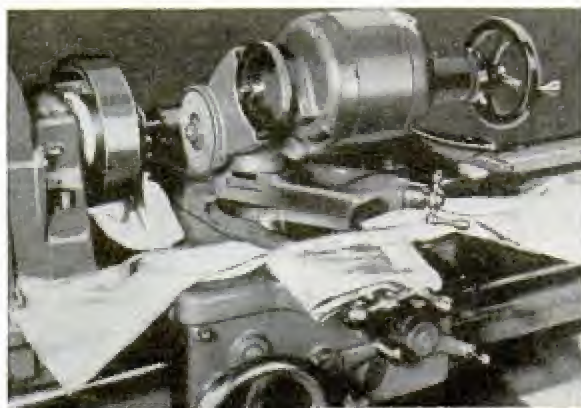
⑩ KEEP THE LATHE COVERED WHEN NOT IN USE, ESPECIALLY WHERE THERE IS EMERY OR ABRASIVE DUST

el of the rest, they may cause chattering.

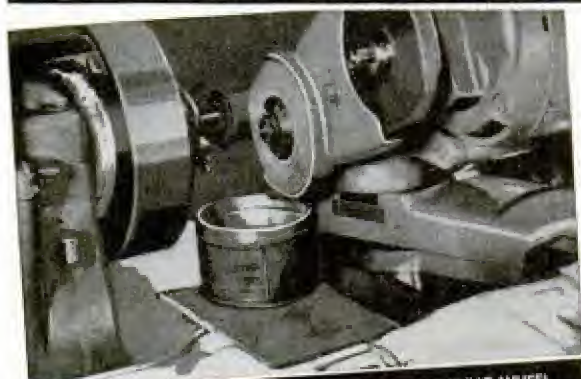
Periodic inspection: The felt wipers on the saddle and tailstock base should be inspected periodically. If there is evidence of grit or small chips, the wipers should be removed and cleaned in kerosene. Oil holes should be plugged or covered at all times to prevent dirt from getting into the

gearing of the headstock, apron or gear box. Oil reservoirs in the headstock and in the apron should be drained, flushed with kerosene and refilled with the proper oil occasionally. See Figs. 8 and 9. Note that a suction pump is used to drain the headstock spindle oil wells.

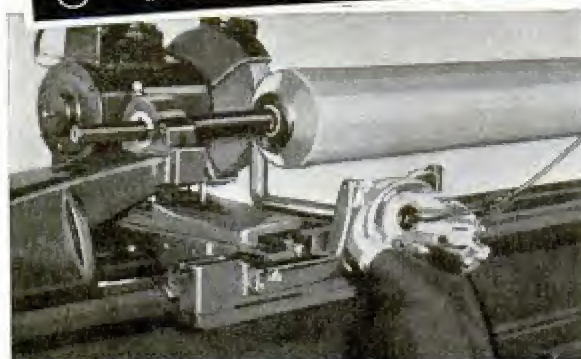
Lathe protection when grinding: Grinding and buffing wheels, polishing tumblers and other such equipment should not be located near a lathe that is not suitably protected against abrasive dust, which causes rapid wear of moving parts if it gets between them. In cases where a grinder is located near a lathe, an effective dust collector should be installed for the grinder, and the lathe should be kept covered when not in use as shown in Fig. 10. Also, when a toolpost grinder is used on a lathe, the ways and other bear-



11 BED AND BEARING SURFACES SHOULD BE COVERED WHEN A TOOLPOST GRINDER IS USED ON THE LATHE



12 CATCHING EMERY PARTICLES FROM A GRINDING WHEEL IN A CAN OR CUP CONTAINING OIL OR WATER



13 VACUUM CLEANER WITH FITTINGS IS INSTALLED TO CATCH DUST WHEN GRINDING RUBBER AND PLASTICS

ing surfaces must be protected from emery dust by covering them with oil-cloth or canvas, and the spindle should be wrapped with a clean cloth as shown in Fig. 11. To collect much of the emery dust, a can of oil or water is placed under the grinding wheel as in Fig. 12. After such grinding operations, the lathe should be cleaned with considerable thoroughness. Products of rubber or fiber, plastic, etc., contain abrasive constituents and also necessitate extra cleaning precautions when these are ground and machined. A good dust-exhaust system with an intake placed directly below the grinder can be improvised from an old vacuum cleaner attached as in Fig. 13.

Keep the belts clean: Oil is harmful to both leather and rubber belts and causes them to slip. Belts and pulleys should be kept free from oil, dirt and chips. Leather can be cleaned with saddle soap or carbon tetrachloride, and a little neat's-foot oil will keep the leather pliable. Sticky, gummy belt dressing should not be needed and is not recommended as it collects dirt and chips. When the belt tension is properly adjusted, a clean dry belt will transmit all the power required for machining any work within the capacity of the lathe.

Lubricant for Lathe Center And Steadyrest

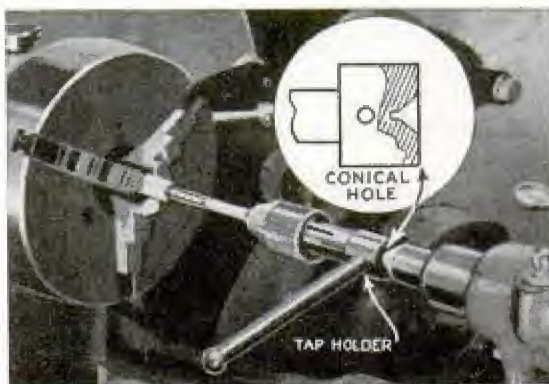
One of the best lubricants that I have ever used for lathe steadyrests and tailstock centers is made by mixing litharge with oil and grease. First, mix just enough light cylinder oil, S.A.E. 10 or 20, with the litharge to form a thick paste and then add to this an equal amount of the heaviest universal-joint grease, stirring until thoroughly mixed.

—R. J. Wright, Los Angeles, Calif.

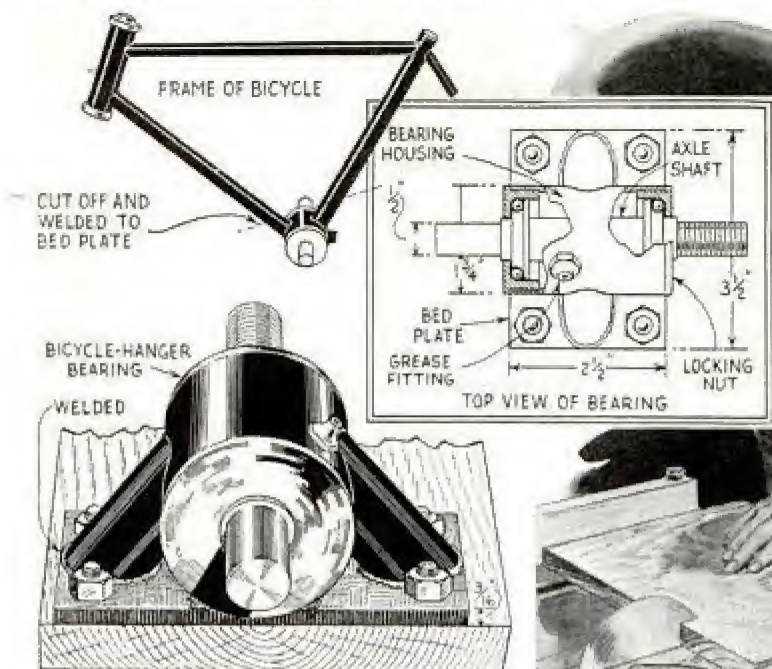
Conical Hole in Wrench Aligns Tap With Work in Lathe

When using a hand tap wrench between centers of a lathe to tap work held in the chuck, a conical hole made exactly in the center of the handle end of the wrench will simplify the job. If the hole is made as indicated in the circular detail, the wrench and tap will be automatically aligned with the work when the tailstock center is moved forward to engage the hole in the wrench. Also, after the tap is started, the hole will tend to keep it in alignment as the center is moved forward to stay in contact with the wrench.

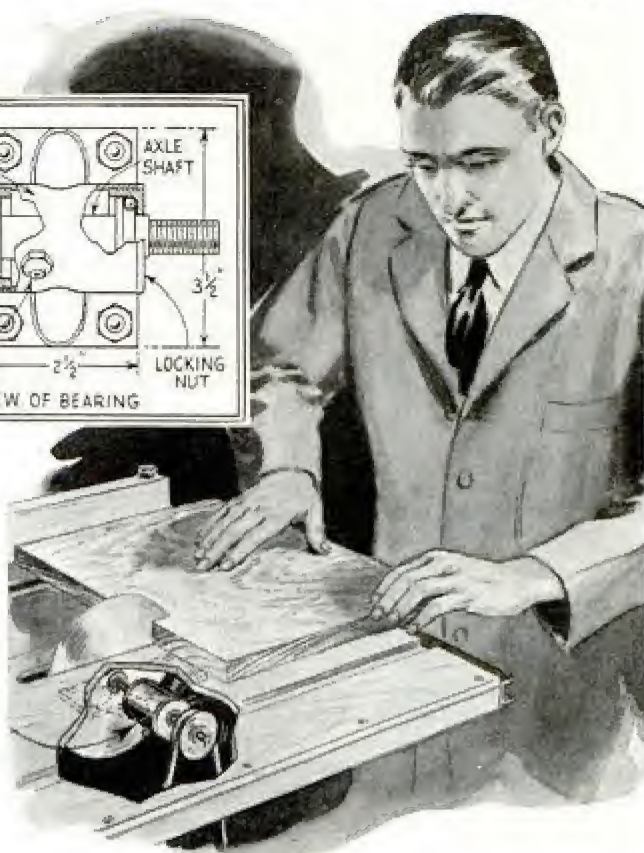
—Robert Clark, Chicago.



Ball-Bearing Mandrel From Bike Pedal Hanger



With very little alteration, a bicycle hanger assembly provides a rugged, inexpensive ball-bearing mandrel for a homemade power grinder, circular saw and similar high-speed tools



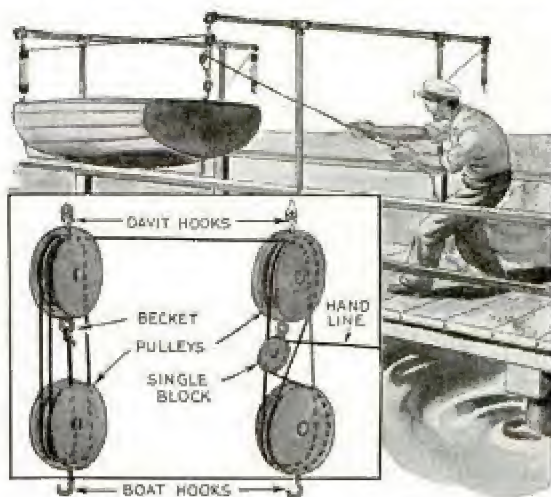
If you are planning a homemade tool that requires the use of a mandrel, such as a grinder, table saw, etc., the pedal-bearing assembly of a discarded bicycle will provide a ball-bearing mandrel that is free running and dust tight. Saw the frame to sever the hanger and weld the remaining stubs to a metal plate to simplify mounting the assembly. Then remove the pedal

cranks and turn down the projecting ends of the shaft to the desired diameter; usually a $\frac{1}{2}$ -in. diameter is the most suitable. Threading the turned ends of the shaft so that nuts can be driven on in the direction opposite that of the rotating saw or grinder, completes the job. If desired, a grease fitting can be fitted on the housing to simplify lubricating the bearings.

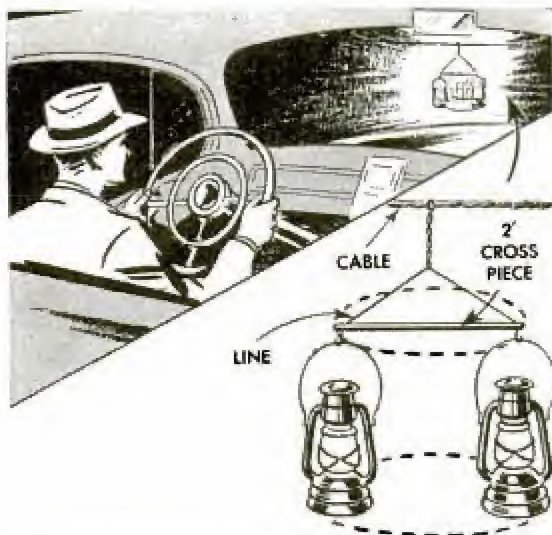
Block-and-Tackle Arrangement for One-Man Boat Lift

Where a boat must be lifted vertically to a dock, this tackle arrangement enables you to do the job singlehanded. Although double blocks are indicated here, blocks having more sheaves can be used if the weight of the boat requires them. With the arrangement shown, the hand-line pull will be equal to one third the weight of the boat plus the resistance of friction in the sheaves. This pull is decreased proportionately as more sheaves are used, or increased as less sheaves are used. In any arrangement, the number of sheaves must be equal in all the blocks. One of the top blocks must have a becket for the load end of the rope and the other top block a becket for the single block at the hand line.

—J. W. Naylor, Niagara Falls, N. Y.



Self-Revolving Pair of Lanterns Emphasize Warning Signal

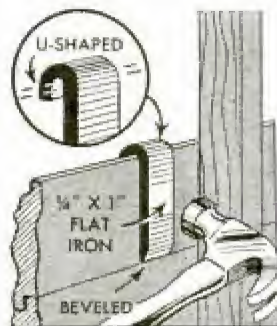


To be sure that a warning signal would be noticed at a sufficient distance for cars to stop, one construction foreman hung a pair of lanterns on a crosspiece suspended from an overhead cable. A double line was attached to the cable and to the ends of the crosspiece so that the slightest breeze would keep the lanterns in motion by winding and unwinding the supporting line.

Easy Way to Locate Leaks In Hot-Water Heaters

If there is a leak in the core of a car heater and it is difficult to locate for repairing, put the core in a bucket or pan of hot water and then apply light air pressure inside the core. In most cases, the leak will show up immediately as the heat of the water will expand the core.

Hammer Pad Removes Siding Without Damaging It



a short U-shape while the other end is beveled. In removing siding that is nailed directly to the studs, the pad is used as

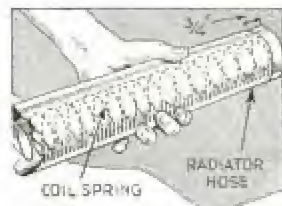
In removing old siding without splitting it when wrecking buildings, a carpenter uses several metal hammer pads of various lengths, each being slightly shorter than the standard widths of siding. One end of each pad is bent to

indicated, the hammer blow being distributed in such a way that it loosens the nails in the siding without splitting it. On sheathed work, the pad is used as a wedge.

Collapsing of Radiator Hose Prevented by Coil Spring

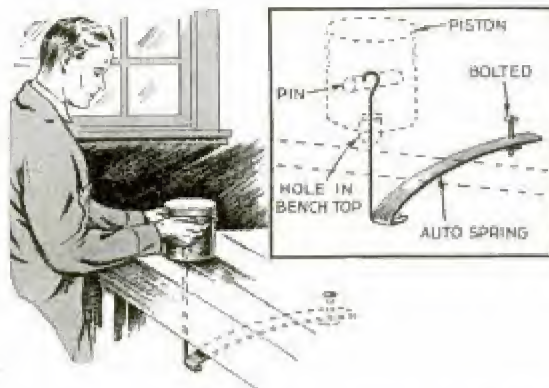
Radiator hoses on tractors often have the tendency to collapse when under heavy duty. A good way to avoid this is to place inside the hose a coil spring that fits snugly and is about $\frac{3}{4}$ to 1 in. shorter than the hose itself. The spring will keep the hose stiff and no more trouble will be experienced from it.

—Herb Arrall, Newburyport, Mass.



Pistons Held by Spring Hook While Fitting New Rings

One mechanic suggests the spring hook shown to hold pistons conveniently for fitting rings. It consists of a leaf from an old auto spring bolted horizontally to the underside of the bench, the spring



having a stout hook attached at one end to project through a hole in the bench top. In use, the spring is pushed up so that the hook may engage the pin in the piston, after which the spring tension holds the piston firmly against the bench.

Simple Condenser Repair

If you are ever stranded on the road because the condenser in your distributor failed, try the following: Remove the condenser (in some cases even this is unnecessary) and with a ball-peen hammer concave the butt end of the condenser cartridge. In an emergency this can be done

with any suitable instrument available. The main object is to tighten the condenser in the cartridge. This repair will be of no avail in case of a "short" in the condenser. However, I have found that in most cases the trouble is caused by an open circuit, in which case this repair is effective.

—Louis de Villeneuve, Roscoe, Calif.

Cushion Spring Soldered in Pan Keeps Damp Chamois Handy

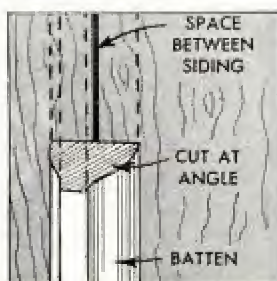


To keep a dampened chamois or sponge conveniently at hand for cleaning windows and windshields, one station operator has a small water pan in which is soldered a seat-cushion spring. The chamois or sponge which is

kept on top of the spring, is immersed by pressing down on the spring.

Abutting Ends of Barn Battens Beveled to Shed Water

When fitting battens on vertical barn siding, one carpenter bevels the abutting ends of the battens instead of cutting them off square. In this way, the beveled end of the lower batten acts as a watershed, makes a neat joint and tends to prevent absorption of water into the end grain. The cut ends of the battens should always be painted before nailing them in place.



Removing Steering-Gear Shaft

Here is a way to save time when removing the steering-wheel shaft from Chevrolets of 1940 and 1941 models, without having to loosen or remove the gear-shifting parts. First, remove the nut that holds the steering wheel on the shaft and take off the wheel. Next, loosen the lowermost jacket clamp, also the frame bolts in the steering-gear housing. Now, raise the front end of the car chassis on a jack, and then pull the steering-gear shaft and assembly out from the bottom of the car.

Customer Aided by Tape Measure Cemented Under Showcase Top



As an aid in helping his customers to determine the lengths in inches or feet of articles that they wanted, one hardware dealer cemented a tape measure under the glass top of his showcase. This saved time for his clerks, as the customers could determine the desired lengths from the tape measure and then ask for them in the correct size, thus making it unnecessary for a clerk to show various sizes of the desired article before the customer determined the one necessary for his purpose.

Rolled Blueprint Kept at Hand By Slipping It Over Funnel

If you are working on a bench job that requires the use of more than one blueprint sheet, just roll the sheets not in immediate use and slip them over inverted funnels. This keeps the sheets within easy reach and prevents them from becoming soiled by coming in contact with tools, or by having soiled work laid on top of them.



❑ If a brace to hold an auger is unavailable, use a faucet handle, which is slipped over the square tapered end so that it can be turned by hand.



Machining with



Turning tools



Capable of withstanding excessive loads and extreme wear at increased speeds and feeds, carbide tips on all kinds of machine tools enable today's fast and steady stream of production at reduced tool cost. This article gives basic information on the use and care of carbide-tipped tools; tells how to grind and lap the cutting edges for greatest efficiency, how to braze tips to shanks, and contains other essential data that every machinist should know

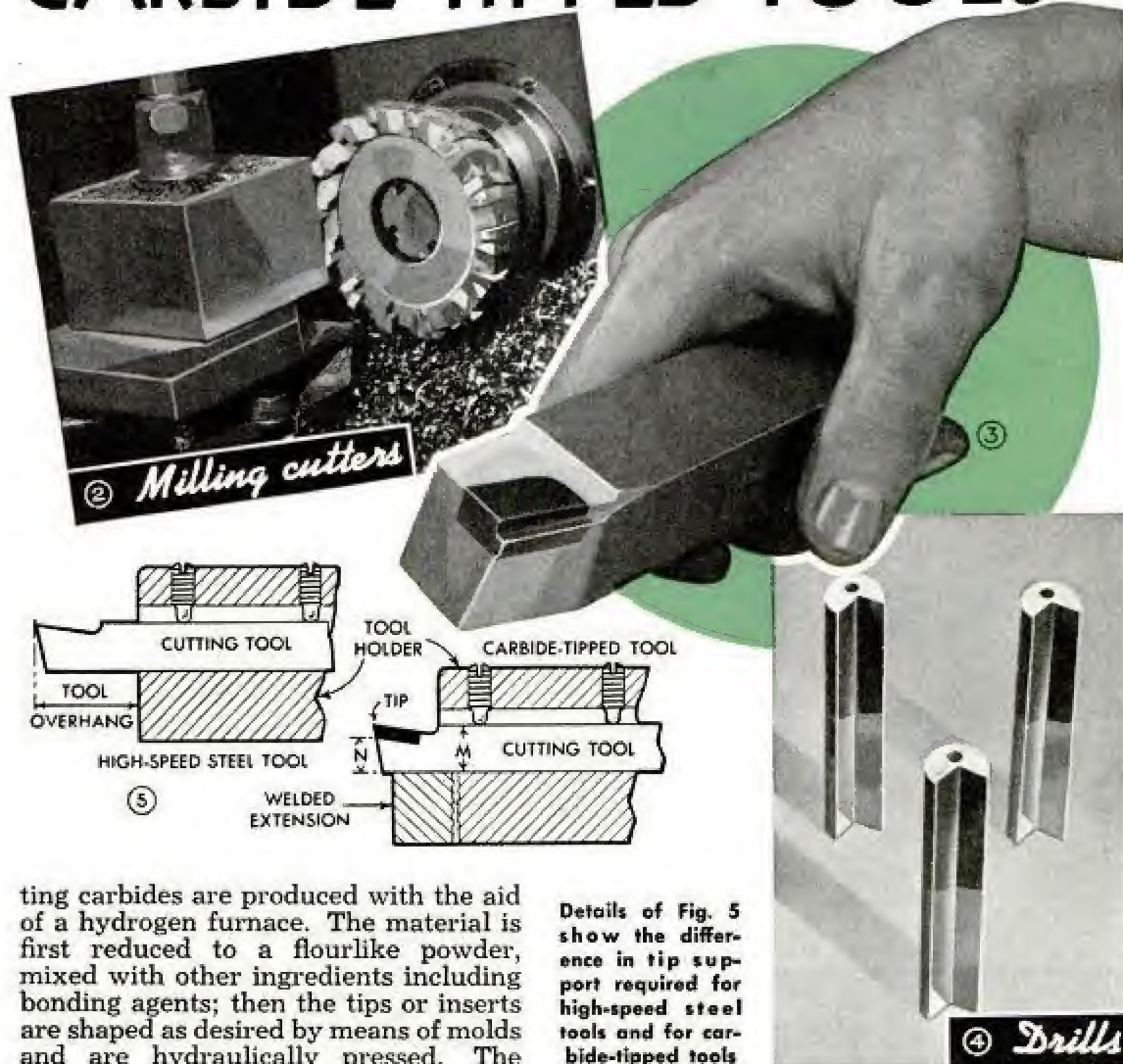
By H. J. Chamberland

OVER fifty percent of all industrial machining operations are performed with various types of cutting tools tipped with carbide. When properly designed, correctly ground and so maintained, carbide-tipped tools never fail if there is adequate power to carry them along. The vertical boring mill shown in Fig. 16 removes chips at the rate of more than 600 lbs. per hour, and the one shown in Fig. 22 was photographed when turning a pulley 10 ft. in diameter. Speeds and feeds are dependent on the nature of the material being machined and the cuts desired, but can be increased substantially over those of high-speed steel tools, and the tool cost can be reduced considerably.

Have many uses: Available under various trade names, carbide tools are extremely hard and very brittle. Originally intended to machine cast iron or castings with hard scales, today these tools are being used to machine nearly all materials, especially where cutting loads and wear are excessive. In common use are not only carbide-tipped lathe tools, such as the assortment shown in Fig. 1, and milling cutters, Fig. 2, but also carbide-tipped twist drills, reamers and related tools, as well as many taps. Also, many micrometers and gauges have carbide contact points. Carbide-tipped tail centers in lathes will outwear twenty to thirty high-speed steel centers. Some solid carbide drills used for gun-barrel drilling are shown in Fig. 4.

How tips are made: Tungsten-titanium carbide is unlike other metals that are fused or cast: It is only one-half as strong as high-speed steel but its hardness is a close second to that of the diamond. Cut-

CARBIDE-TIPPED TOOLS



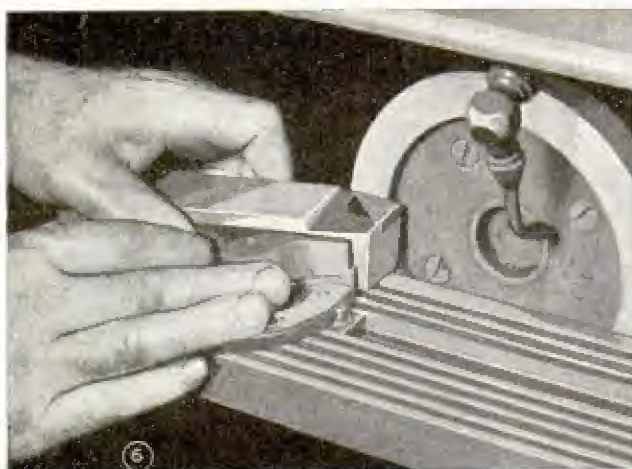
ting carbides are produced with the aid of a hydrogen furnace. The material is first reduced to a flourlike powder, mixed with other ingredients including bonding agents; then the tips or inserts are shaped as desired by means of molds and are hydraulically pressed. The pressed parts are placed in a hydrogen furnace for a primary sintering or heat treatment to harden them so that they can be machined easily. After machining, they are returned to the hydrogen furnace in receptacles called "boats" for final sintering or hardening. Upon removal from the furnace this time the parts are diamond hard and ready to be brazed to tool shanks or bodies. The tips are available in various grades and, while one particular grade may prove quite effective for the general run of work, it is most economical to use the grade adapted to a particular material.

Tips require rigid support: An ordinary cutting tool is made of some material that can be hardened for cutting and possesses sufficient strength to withstand cutting loads. A carbide-tipped tool consists of a carbide tip as the hardness member and a steel shank as the strength member. As shown in the left detail of Fig. 5, a solid high-speed steel tool can stand a substan-

Details of Fig. 5 show the difference in tip support required for high-speed steel tools and for carbide-tipped tools

tial amount of overhang with rigidity but, as shown in the right detail of Fig. 5, a carbide-tipped tool must have a minimum amount of overhang even if it means welding an extension to the tool holder to provide adequate support. Although a carbide tip is very hard, resists wear, holds its cutting edge at high temperatures and allows for surprisingly great machining speeds and feeds, it has very little elasticity. For this reason, it is imperative that the shank and tool holder be made sufficiently strong to prevent bending or giving in the least. Accordingly, dimension N in the right detail of Fig. 5, acting as a tip support, should equal dimension M as closely as possible.

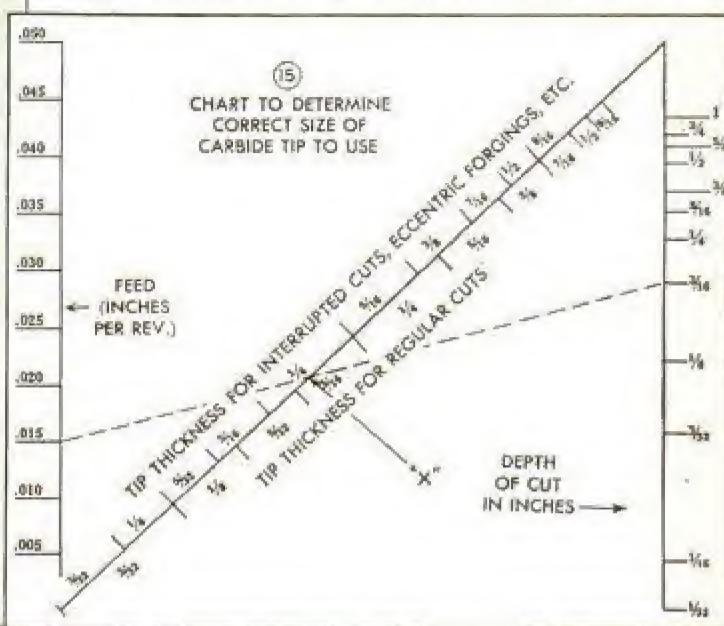
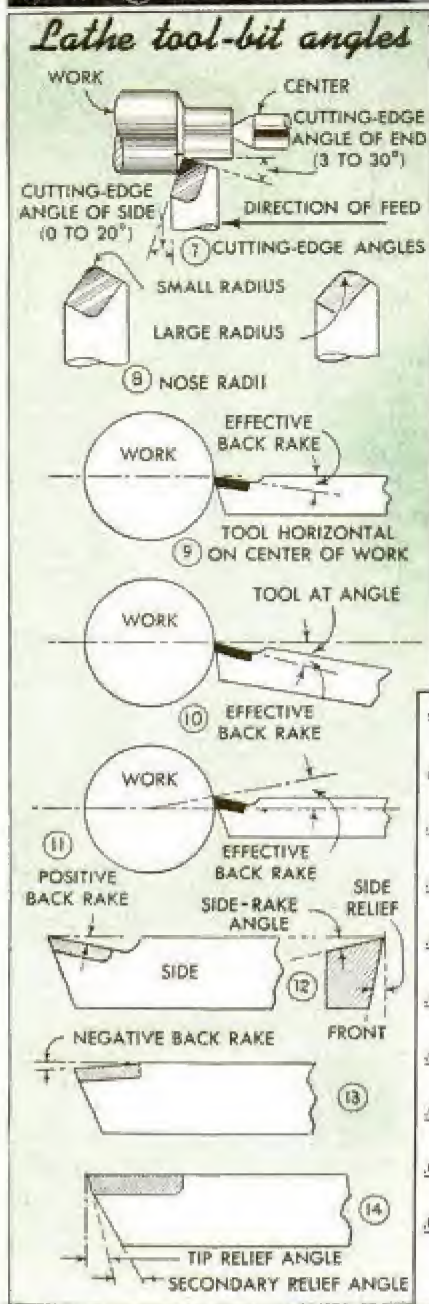
Estimating tip size: A current mistake often made in many machine shops is to estimate the size of the tip incorrectly for a given job and to select a shank that is too weak. The chart shown in Fig. 15 simplifies this problem and is worth while under-



standing thoroughly. In order to use the chart, first determine the depth of the cut to be made and locate this on the right-hand scale. Then locate the feed per revolution on the left-hand scale. Next, lay a straightedge across both of the located points and read the size tip required where the straightedge crosses the solid diagonal line marked X. For example, the dash line in Fig. 15 represents a straightedge line, and the point where it crosses line X indicates that a $\frac{3}{16}$ to $\frac{1}{4}$ -in. tip should be used if the feed is .015 in. per revolution and the depth of cut is $\frac{3}{16}$ inch. The general requirements to determine the size of the shank are as follows:

The deeper the cut, the higher the feed and the more overhang, the heavier will be the shank that is required. Having selected the correct size of tip, it is not difficult to estimate a shank of proper size.

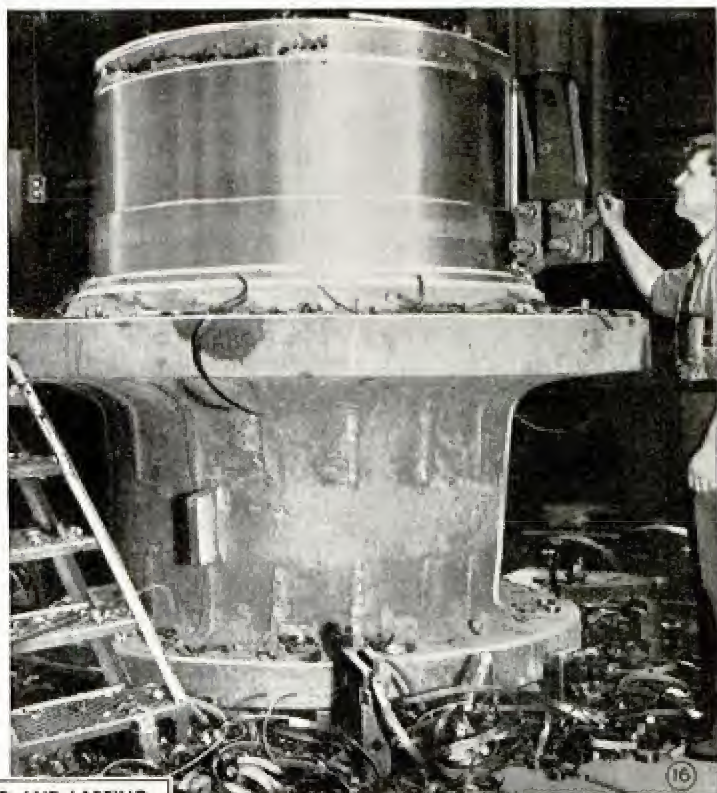
Cutting-edge angles: The design or shape of carbide-tipped tools involves correct side cutting-edge angles, and cutting-edge angles and nose radii, which are all directly related to rake angles. All these should be correlated in order to produce a tool that is most efficient for cutting. As shown in Fig. 7, the side cutting-edge or lead angle, varies from 0 to 20 degrees, depending upon the nature of the cut to be made. Machining to a shoulder requires an angle of only a few degrees, usually 2 degrees. For other work it is advisable to try 15 degrees as a starting point and reduce or increase by experiment. When starting or taking interrupted cuts with a tool having a side cutting-edge angle from 5 to 15 degrees, the load is taken on the tip or point back of the nose where the tool is strongest. A gradual reduction of cutting load eliminates chipping the tip, especially on large-diameter work. The length of the cutting edge is increased so that the pressure per unit of area



on the cutting edge is reduced.

For highest cutting efficiency, the point of contact of carbide-tipped tools should be as small as possible. A $\frac{1}{32}$ to $\frac{1}{16}$ -in. nose radius has been found adequate. As shown in Fig. 8, the larger the nose radius, the smaller the wedge angle will be, and the more pressure is needed between the work and the tool. Increased pressure and drag are detrimental to tool life. Also, chatter usually occurs with too large a nose radius. Although the average angle for the end cutting edge varies from 8 to 15 degrees, it may be as much as 20 to 30 degrees on certain jobs. An angle of less than 8 degrees here may invite chatter due to the nose of the tool being gradually flattened by repeated grindings.

Rake angles are of no less



WHEEL RECOMMENDATIONS FOR GRINDING AND LAPPING CARBIDE-TIPPED TOOLS				
(17)				
For Grinding Steel Shanks Only				
ALUMINUM- OXIDE WHEELS	Roughing	Carborundum	Norton	
	Finishing	24M200	1924L	
		401K-200	1946M	
For Grinding Steel Shank and Tip Simultaneously				
SILICON-CARBIDE WHEELS	Roughing	G-60RW	3960/1-17	
	Finishing	G-100SW	39100/1-H7	
For Lapping Carbide Tip Only				
DIAMOND- IMPREGNATED WHEELS	Average finish	100 Grit	100 Grit	
	Average lap	240 Grit	220 Grit	
	Fine lap	320 Grit	320 Grit	

Carbide-tipped tool in this boring mill removes large chips of steel at rate of over 600 lbs. per hour

of the positive variety. Tools must have tip relief also as shown in Fig. 14.

Chip breakers: Machining of steel presents the problem of a continuous chip, especially at cutting speeds exceeding 250 feet per minute. The chip must be broken into relatively short lengths for safe and economical disposal, which is accomplished by means of a chip breaker, ground in and adjacent to

the cutting edge of the tool as shown in Figs. 3 and 20. Chip-breaker grinding must be done on a diamond-impregnated wheel as no other wheel will cut and give the desired fine finish. Fig. 18 illustrates the correct holding position for grinding chip breakers freehand, while the table in Fig. 19 gives the various widths of chip breakers as computed on the basis of depth of cut and extent of feed involved.

How to grind and lap tips: A grinding wheel used for steel will not cut carbide and vice versa, so keeping carbide-tipped tools in good condition requires a special sharpening technique. After some experience, you will be able to grind them freehand if ample hand support is provided. When the angle of the shank needs regrounding, an aluminum-oxide wheel must be used. When grinding tip and shank angles simultaneously, a silicon-carbide wheel is imperative. To produce final, fine

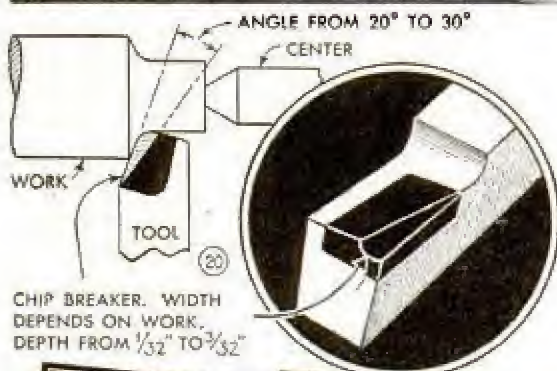
importance to obtain a free-cutting tool, although at times a tool that cuts too freely will not break the chips. In determining rake angles, it is understood that the nose of the tool contacts the work with the shank set at right angles to the work as shown in Fig. 9. When a set-up involves a tool shank held at an angle with a line drawn between the center of the work and the tool contact point as in Figs. 10 and 11, the rake angle should be changed accordingly. Fig. 12 shows a positive back rake and also side rake. As the tool is reground, shims must be used to bring the cutting edge of the tool to correct position. A negative back rake, shown in Fig. 13, allows for wider distribution of the load over the tip area. Negative back rakes vary from 2 to 8 degrees, 5 degrees being considered as a starting or experimental point. When a negative back rake is used, other rake angles should be several degrees greater but



Chip breakers

Depth of cut in inches	(19) WIDTH OF CHIP BREAKERS			
	Feed in inches per revolution			
	.008 to .012	.013 to .017	.018 to .022	.023 to .027
$\frac{1}{16}$ to $\frac{3}{16}$	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$
$\frac{3}{16}$ to $\frac{1}{2}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$
$\frac{1}{2}$ to $1\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{4}$	$1\frac{1}{2}$	$2\frac{1}{2}$
$1\frac{1}{2}$ to $2\frac{1}{2}$	$1\frac{1}{2}$	$2\frac{1}{2}$	$4\frac{1}{2}$	$7\frac{1}{2}$

Note: A chip-breaker depth of .020 in. usually satisfactory for most steel



CHIP BREAKER. WIDTH
DEPENDS ON WORK.
DEPTH FROM $\frac{1}{32}$ " TO $\frac{3}{32}$ "

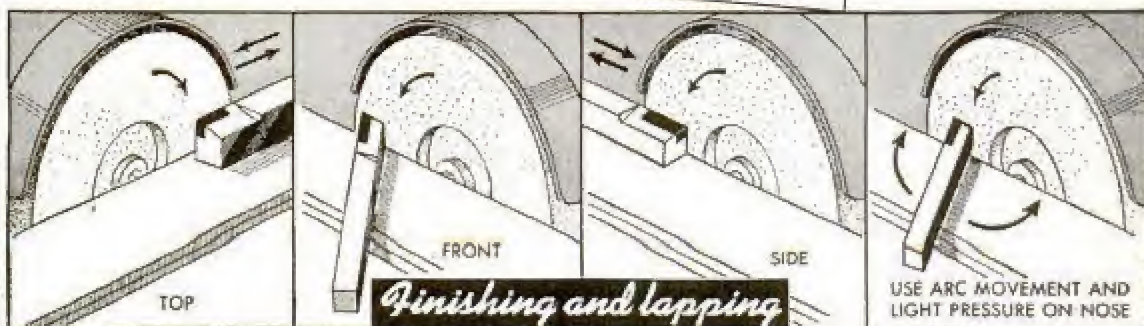
finishes on the carbide tip, nothing but a diamond-impregnated wheel will do. Fig. 6 shows a tool being lapped with a diamond-impregnated wheel. Fig. 21 gives the various steps in roughing in, finishing and lapping lathe cutting tools. For roughing, which is done on the front of the wheel, the top face is first, then the front relief and finally the side relief. In the finishing or intermediate operations, done on the side of the wheel, the sequence is the same, but for the lapping operations, also done on the side of the wheel, the top face is first, then the side relief, followed by the front relief. Lapping the nose of the tool is accomplished by moving it in an arc, back and forth, applying a very light pressure. Fig. 17 gives recommendations for various grades of wheels to use to keep carbide-tipped tools at their maximum cutting efficiency.

Brazing tips to shanks: Carbide tips can be brazed to tool shanks in most shops economically. Torch-brazing, as in Fig. 23, is most common although many shops resort to furnace-brazing. Cleanliness in brazing is as essential as it is in welding. Therefore, all parts

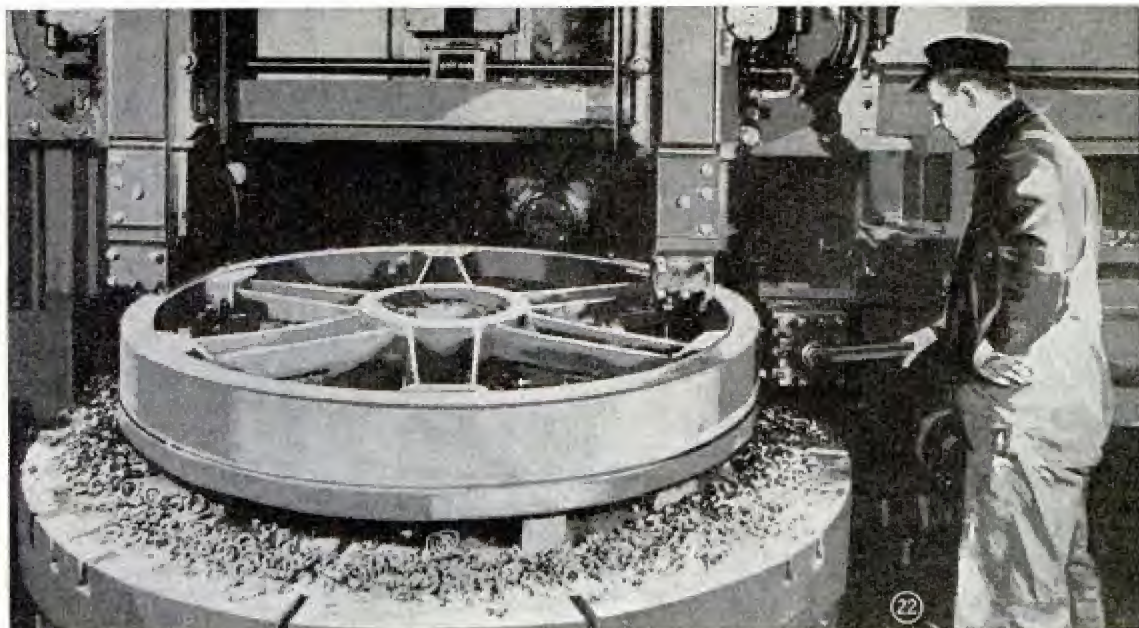
Roughing lathe tools



Work and time spent in keeping tool bits sharp will pay "dividends" in increased production. At the left are several steps involved in roughing lathe tool bits and below are shown the operations of finishing and lapping them



Finishing and lapping



In this immense boring mill, two heavy carbide-tipped tools are used to machine a pulley 10 ft. in diameter

should be cleaned thoroughly with carbon tetrachloride beforehand. Silver makes a dependable braze, both the carbide tip and the shank being tinned as in Fig. 24. It is customary also to braze tips as shown in Fig. 25 with a special brazing sheet of copper or similar alloy. Multi-tip brazing can be performed easily by following the method shown in Fig. 26. In all cases the radius of the edge of the tip, where it fits into the milled portion of the shank, should be larger than that on the shank. High-silicon steels and straight carbon steels with a high carbon content should be used for shanks. The torch should be adjusted to deliver a nonoxidizing flame, and it should be kept moving back and forth to avoid burning the shank. It is advisable to pre-heat the work by applying the flame to the sides and bottom of the shank, then carefully to the tip. When furnace-brazing, the tool shank is preheated in a muffle furnace to 1,600 degrees Fahr., with an ample supply of borax covering the milled section. Scraping should be done immediately after removing the work from the furnace. The tip is similarly preheated but to 2,200 degrees Fahr., after placing a sheet of brazing foil over the blank and covering thoroughly with borax. When the sheet melts and flows freely, the tip is removed from the

furnace as quickly as possible, is positioned on the shank and pressed in tightly. Regardless of the brazing method used, the work always should be cooled by air—never by immersing it in water.

Some plants prefer using tools on which the carbide tips are clamped to the shanks as illustrated in Fig. 27, the claim being made that there is less breakage due to the absence of brazing strains. This method permits tips to be changed from one holder to another and also simplifies the work of grinding them. It has been reported that twice as many pieces of work per grind becomes possible by adopting this method of holding tips to shanks.

Coolant: A coolant is recommended when using carbide-tipped tools to machine steel, aluminum, brass and many grades of ferrous castings of the close-grain variety. The latter form chips in lengths rather than powdery chips as from the gray irons. It is imperative that a tank, pump and supply line of sufficient capacity

be provided to give a large volume flow of soluble oil at a high velocity. Any rise in temperature that will offset the effectiveness of the coolant must be avoided. In numerous cases, the coolant is directed from the top and bottom, or from both sides of the tools. Sometimes tool blocks are drilled for pipe

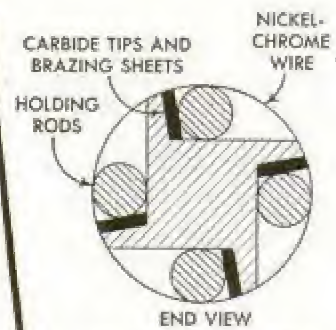
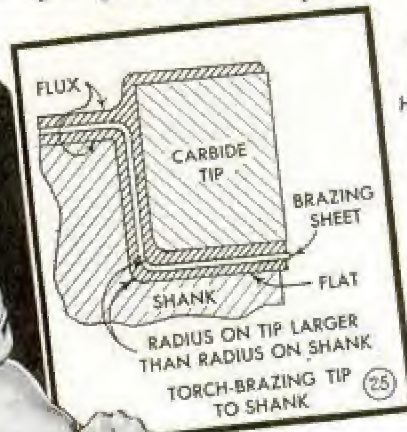
Don't _____

- 1—hammer cutting tips in any way
- 2—dip tool in any liquid while hot
- 3—stop spindle without disengaging feed
- 4—use an overhang beyond absolute minimum
- 5—spare coolant when and if it is required
- 6—lay a carbide-tipped tool on a machine bed
- 7—use any but silicon-carbide or diamond wheels
- 8—use any but dog-point and flat clamping screws
- 9—use tools too long before stoning or sharpening
- 10—have tool against work when tightening clamp screws
- 11—press carbide tip against wheel but traverse lightly
- 12—use a holder not expressly designed for carbide tools

Brazing carbide tips



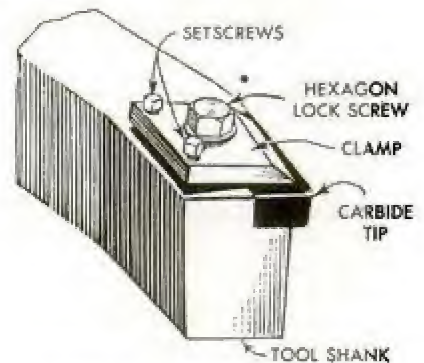
(23)



(26) TORCH-BRAZING CARBIDE TIPS IN MULTIPLES



(24)

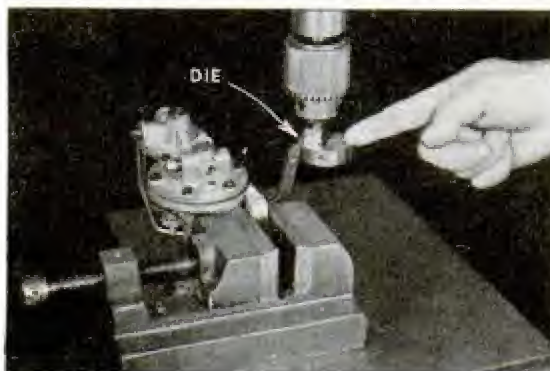


(27) STRAP-ON STYLE CARBIDE-TIPPED TOOL

connections to provide an unobstructed flow of coolant directly to the nose of the tool. Always be sure to select a coolant that is best suited to the particular kind of metal being machined and to operating conditions such as speed and the depth of the cut.

Testing Operation of an Auto Fuel Pump on a Drill Press

It is always a good idea to test a fuel pump before installation to assure that it is operating correctly. Such a test can be made by clamping the pump in a vise which is fastened securely on the table of



a drill press, as shown. Then the drill press is operated at its lowest speed, using a threading die in the chuck to function as a pump-operating cam. Any large die can be secured to a $\frac{3}{8}$ -in. bolt passed through one of the clearance holes to provide an eccentric action. In this set-up, the pump will operate in a normal manner, and by connecting lines to the intake and outlet of the pump its ability to lift fuel will be demonstrated. Any pump that cannot lift gasoline to a height of 3 ft., and then force it up another 3 ft. should be checked for leaky valves, defective diaphragm, or weak springs. If there should be any sign of leakage at the pump during this test, the necessary repairs should be made before the pump is installed on the car.

—C. E. Packer, Chicago.

Hook Spacers on Scaffold Prevent Rope Wear

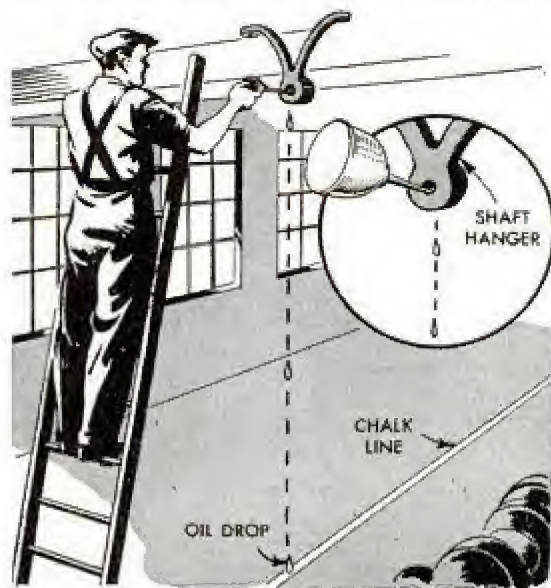
When using a scaffold that is suspended from the top of a building by large hooks as shown at the left, the blocks often are held so close to the building that the ropes rub against the wall. This causes them to wear rapidly to the breaking point and endanger the lives of the workmen. To avoid this trouble, one contractor uses the illustrated attachment, which fits over the lower end of a hook to hold it away from the wall. The attachment is nothing more than a large pipe nipple fitted with a floor flange at one end and slotted at the other end to straddle the hook. One half of a pipe coupling is used as a nut to screw over the slotted end of the nipple and clamp it firmly in place on the hook, making the attachment easy to remove when it is not needed.



Drops of Oil Help to Align Shaft Hangers With Machines

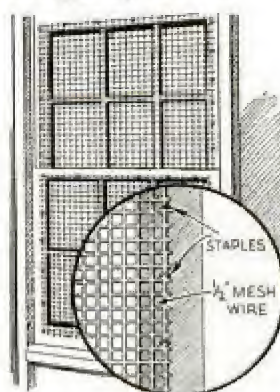
To adjust overhead shaft-hangers to the relative positions of machines to be set on the floor underneath them, one workman draws a chalk line on the floor to indicate the desired location of the shafting and

then drops oil from the boxing of the hanger to determine when it is in proper alignment. If there is no air current to deflect the drops, this method is accurate.



Wire Stapled to Hayloft Windows Prevents Breakage by Birds

As pigeons and other birds trapped in the dim light of a haymow will fly directly at the windows in an effort to get out, broken panes often result which are tedious to replace. To eliminate this nuisance, one farmer screened all the loft windows with $\frac{1}{2}$ -in. mesh wire. This is stapled directly to the sash so that it does not interfere with raising and lowering the windows.



Special Hooks in a Refrigerator Simplify Hanging of Meat



To avoid using a short stepladder inside his cooler to reach meat hanging from high racks, one butcher uses hooks having loops or eyes bent in their centers like the one shown. These hooks and the meat can be removed with a short pole, which has an opened screw eye near one end to engage the loops in the hooks, thus enabling him to remove or replace the meat on the racks while standing on the floor.

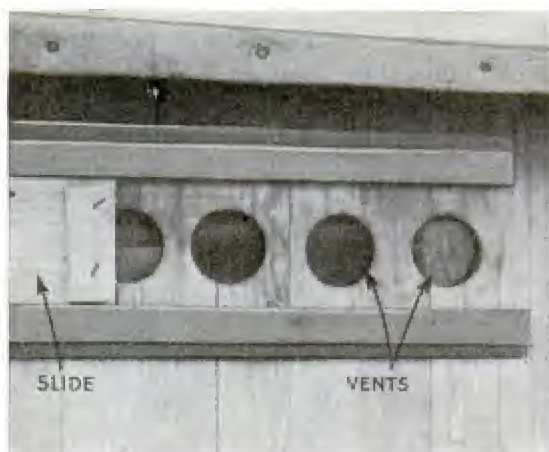
Right Way to Paint Greenhouses

As greenhouses are subjected to unusual weather conditions, both inside and out, they must be cared for more diligently than most buildings. Fungus growth, such as mildew, may form on paint where too much linseed oil has prevented firm drying. An increase of the turpentine content when painting is a usual procedure to avoid this trouble. An added preventive to fungus growth is the use of calomel (mercurous chloride)—a poisonous chemical. Experience has proved that pure white lead and oil provide a most economical paint, which forms a firm but elastic cover. Elasticity is necessary because of the vibration and sway of the expanse of glass. Also, white lead has reflective qualities, is moisture resistant, and wears down slowly and uniformly. Before applying new paint, however, all surfaces should be dry and clean. Surfaces on which the paint has cracked or peeled should be scraped clean, sandpapered smooth, and then brushed.

Loose putty and stains should be removed, and all exposed sash should be primed before reglazing to prevent the wood from absorbing oil from the putty. When painting on a regular two-year schedule, only one outside coat is necessary if a mixture is used consisting of white lead, 12 parts, raw linseed oil, 10 parts, and liquid drier used in the proportion of 1 pt. for each 100 lbs. soft white lead paste used. For interiors, one coat of equal parts soft paste white lead and lead-mixing or lead reducing oil will suffice if covering an original three-coated surface. In painting new work, follow manufacturers' priming coat with one consisting of soft white lead 2 parts, raw linseed oil 1 part, turpentine 1 part, and one pint liquid drier per 100 lbs. of lead. A longer interval between interior jobs will require scraping down to the priming coat and touching up with white or red lead. Two coats of paint as previously described may then be applied.

Ventilator for Brooder House Is Easy to Adjust

Costing nothing to make, this brooder-house ventilator can be adjusted to suit various weather conditions. To make it, first drill several large holes in the wall and then fit a slide over them. A wide, thin board will do for the slide, which works in grooves formed by nailing a couple of slats to blocks for spacing the slats the neces-



sary distance from the wall of the building. In use, the slide is moved to cover or uncover the holes necessary to give the desired ventilation. A little melted paraffin applied to the grooves and to the edges of the slide will make it easy to move.

¶ Before painting window frames, smear soap on the glass near the edges and splattered paint can be removed easily.



RUNNING DOWN HUM BUGS

HIGHLY sensitive receivers often pick up hum from nearby electrically operated devices such as clocks, lamps and fans. Lamps and clocks that are placed directly on top of radio cabinets are common offenders. The obvious first-aid remedy would be to locate the source of the trouble and remove or replace the interfering device. In the case of clocks, fans and stand lamps it may be necessary only to move them a few feet away from the set.

Power leaks, arcing switches and lamp bulbs that are deteriorating, produce interference that can be located quickly by means of a simple "pickup" or exploring coil and a pair of headphones assembled and operated as indicated in Figs. 2 and 3. The adjustable coil can be wound with practically any small size of insulated wire on a short length of cardboard mailing tube as detailed in Fig. 2. The flat metal strip provides a swinging joint so that the pick-up coil may be tipped to the proper angle and held parallel to the line at the appliance by means of the long stick. Any interfering noise will be greatly increased in the phones as the source is approached. Repairs can then be made in the device, or old light bulbs replaced with new ones.

When hum originates in a resistance-coupled audio amplifier stage of the receiver, the remedy often employed by radio servicemen and experimenters is a simple decoupling filter of the type shown in Fig. 1. The condensers used are paper by-pass variety, not elec-

(Continued to page 162)

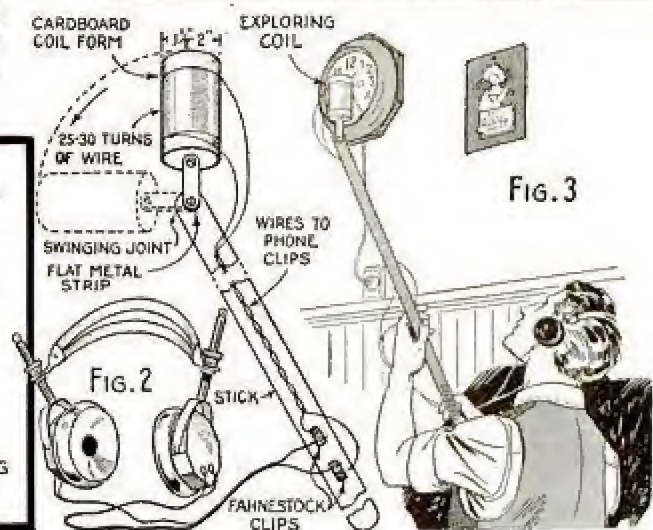
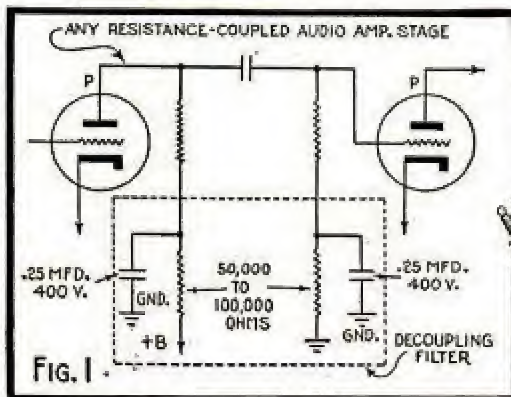


FIG. 3

PAPER "MORNING-GLORY" HORN

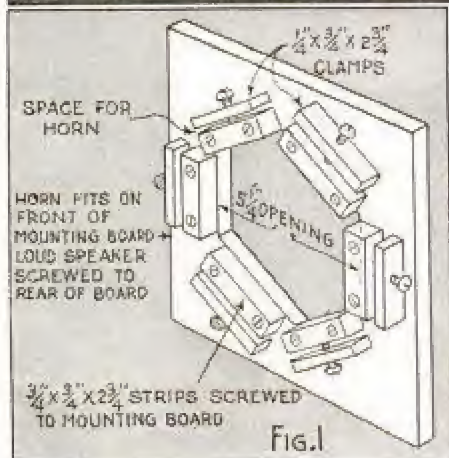
By R. C. Hitchcock



CORRUGATED paper cut from old shipping cartons provides practically all the material necessary to make an ordinary "baffle board" speaker sound nearly twice as loud as before. Better bass response, as well as good efficiency over the whole audible range can be obtained by the use of this exponential or "morning-glory" horn on any dynamic loudspeaker. The trumpet arrangement projects full power directly toward an audience and allows gradual expansion of the sound-wave front thus preventing disturbance from turbulent-air eddy currents. The method is not new and the advantages of a "straight" trumpet are well known to sound men.

Although this horn is made of ordinary corrugated paper it is surprisingly strong. The one shown in the photos has stood up well under constant use in a college classroom and has also served for recreation room entertainment. The stiffness is due to the continuous curves and the use of strips of gummed tape employed to hold the sections together.

The mounting board dimensions shown in Fig. 1 were for a 10 in. diameter speaker. Wood clamps are employed to hold the small end of the horn on the mounting board; these wood clamps are screwed to the board, the loudspeaker being screwed to the other side of the mounting board as illustrated in photo A. Metal angles were used as clamps in the original model as will be noted in photo B; the wooden clamps serve the same purpose and avoid the use of metal. An old drawing board makes a good mounting board; the speaker unit can be mounted on a block or box of correct size to bring the horn assembly to



INCREASES SPEAKER OUTPUT

the proper height as indicated in photo C.

Six identical pieces of the corrugated cardboard are cut to the dimensions given in Fig. 2. These pieces should be cut with the corrugations running crosswise, for ease in bending during assembly. If the paper is too flexible it may be advisable to reinforce the last few inches on the big end with a strip of the same material. A good job will depend upon careful measurements and accurate cutting. It is a good idea to make a template of heavy paper or bristol board and use it as a cutting pattern. Measure off the expanding diameters every 6 inches and place dots for drawing the curve. Do this carefully and then cut out the pattern which will be 36 in. long, $4\frac{1}{2}$ in. wide at the small end, and 24 in. at the large. A sharp knife or a large pair of shears should be employed to cut the corrugated board to obtain clean edges.

Ordinary gummed paper tape of the type used to seal large packages is used on both the inside and outside of the cardboard section pieces to form the hexagon horn as shown in Fig. 3 and photo C. The completed horn, Fig. 3, is $41\frac{1}{2}$ in. across the flats, and 48 in. across the corners of the hexagon. You will probably need an assistant when applying the gummed paper strips to hold the sections together. Working on a low table, the assistant holds the sections upright by the small end, while you bend them in position and apply the tape on the outside edges. This is not difficult but requires patience as the gummed tape must be placed in position quickly and evenly before it dries. After all strips are in position on the outside, apply the inside strips and the horn is ready to mount. It is always a good idea to support the front end of the horn on the edge of the table as shown in photo C, or a cord may be used to support it from above in case the table is not long enough for the assembly.

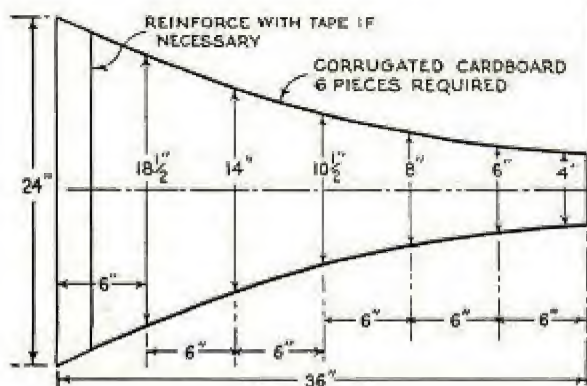


FIG. 2

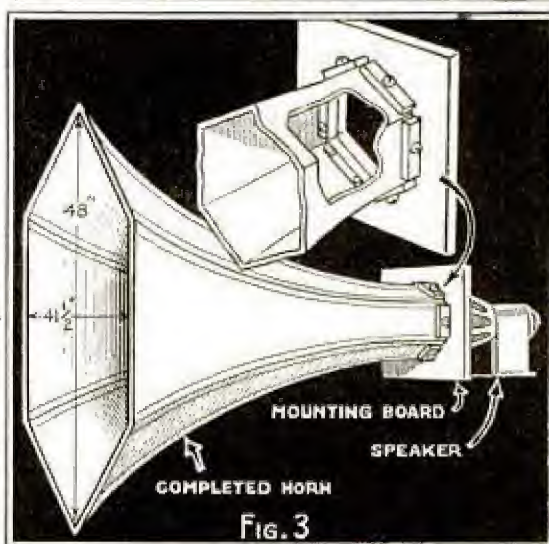
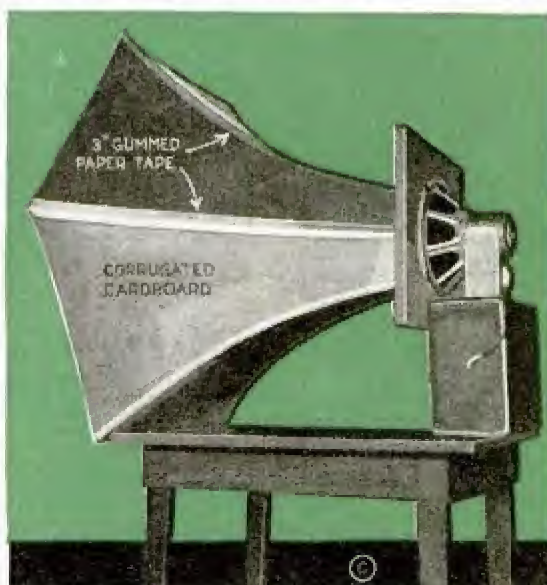
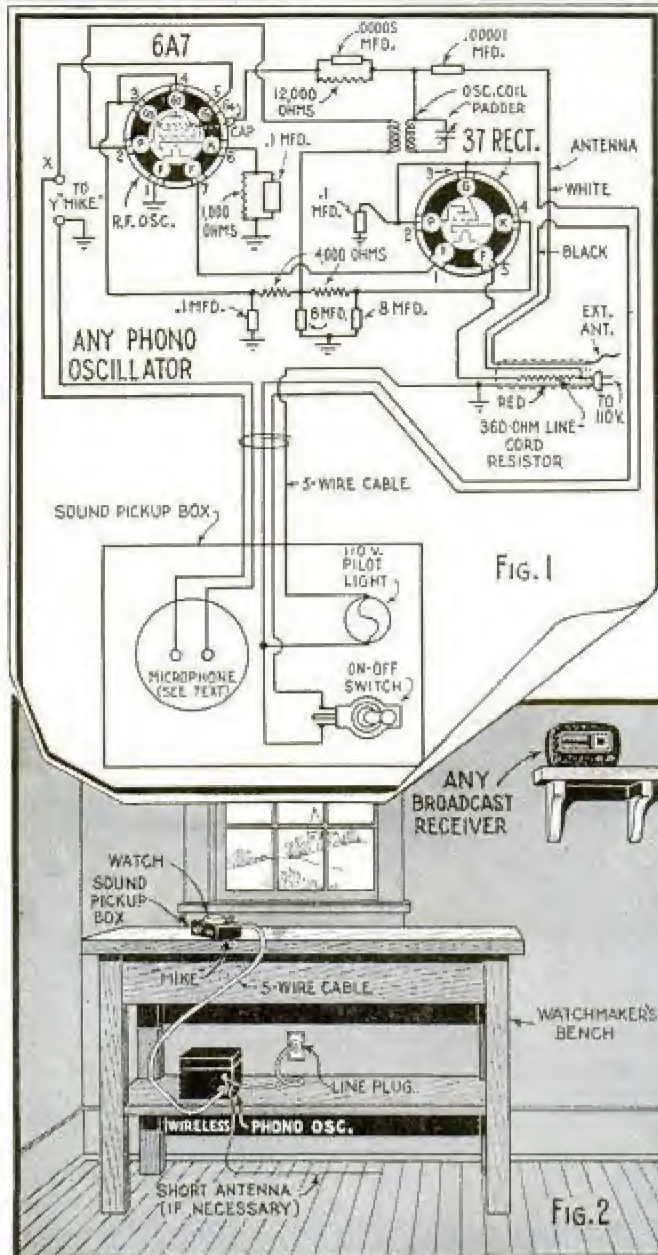


FIG. 3

New Uses for Your "Wireless" Phono Oscillator



EMPLOYED as a sensitive detector and transmitter of sound, your "wireless" phono oscillator can be made to serve many useful purposes other than playing records through your radio receiver. One of these practical applications is the watch-checking aid illustrated in photo A and Fig. 2. Any type of midget receiver can be placed in the room and tuned to the frequency of the oscillator to receive and greatly amplify faint sounds. Police and postal authorities can use a "radio stethoscope" of this type to detect any clockwork arrangement in suspected packages which might house a bomb. In the school laboratory it may be employed to amplify the sounds made by insects or chemical reactions; in the workshop it can be used to check play in the bearings of small motors, etc.

A small flat sound-pickup box is provided to replace the phono pickup arm and this houses a microphone, preferably of the high impedance crystal type, on-off switch, and pilot light with jewel as shown in photos B and C. Small holes are drilled in the top of the box to form the microphone grill. A 5-wire cable connects this pickup box with any standard phono oscillator when wired as shown in Fig. 1. When a crystal microphone is used it will be necessary to connect a 250,000-ohm $\frac{1}{4}$ -watt resistor across the "mike" input terminals X and Y. All ground connections indicated in Fig. 1 are the usual chassis grounds; no external ground is used. If

(Continued to page 162)



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about the cut of
your coveralls



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THIS war has changed fashions in *driving* as well as fashions in clothes. Today, you use your car less . . . make shorter, more infrequent trips.

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Man's Arms and Legs of Steel

(Continued from page 79)

scrap flowing by hoisting into railway cars the bales of crushed automobiles and bedsteads and kitchenware.

Machine guns first went on a conveyorized assembly line at the AC Spark Plug plant, and in another General Motors factory propellers for fighting planes travel in endless chain into electroplating tanks.

Pipe lines, too, serve as mechanical arms and legs; and even ore is now being transported from mines by vertical pipes which substitute for shafts and belt lines and tramways. Broken up underground, the crushed ore is forced to the surface through 12-inch pipes with the help of a magnetic medium.

Pneumatic tubes, man's "mechanical lungs," are one of the most familiar intraplant transport systems, and they have found many new tasks in recent years. More than five miles of tubes were installed in a new government building at Washington to handle inter-office messages. Vital orders are shot by tube between bridge, engine room and other communication centers of U. S. Navy capital ships. One large hospital uses pneumatic tubes to dispatch surgical specimens from the operating room to the laboratory for diagnosis while the patient is still on the operating table. Carriers 12 inches wide, big enough to accommodate blueprints, speed through tubes in a bomber factory and enabled the manufacturer to reduce his blueprint production by 40 percent. And one of the most unusual uses of pneumatic tubes is to carry hot steel samples weighing as much as eight pounds from an open-hearth mill to a chemical laboratory 7,500 feet distant, for quick analysis.

Tubes and conveyors and trackless trains and overhead railways have freed thousands of feet of floor space in busy industrial plants and extended mightily man's reach and strength. As General Electric's supervisor of production and handling has said, "the handling facilities employed in the mill, factory, and at transfer points between transportation media have practically as much to do with our maintaining a continuous flow of supplies to the battle fronts as the final operation, namely, safely conducting merchant ships carrying the fruits of industry and agriculture through submarine-infested waters."

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Armored and armed to the teeth, asking and giving no quarter and operating almost regardless of terrain, the effectiveness of our giant tanks depends on their mobility. Giant engines must not fail, and for that reason the tank corps is very conscious of the importance of spark plugs, and the necessity of regular inspection to keep them in top-notch condition. Champion Spark Plugs have earned an outstanding reputation for dependability here, as with other branches of our fighting forces. This enhances Champion's long standing reputation for better perform-

ance—and emphasizes the reason for their world-wide preference by motorists. . . . Check your spark plugs—have them tested, cleaned and gaps re-set at regular intervals, to insure maximum economy and dependability. When you need new spark plugs insist on Champions.



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SUPERIOR DROP-FORGED TOOLS

Trigger Men of the Big Bombers

(Continued from page 47)

weeks and is divided into two parts—classroom preparation and then practical application of firing on the field and in the air. The classroom work, two weeks of it, consists of description and demonstration of machine guns and all their parts, how they work, sighting, estimation of range, recognition of Allied and enemy aircraft, how to distinguish between Allied surface ships and those of the Axis, operation of oxygen equipment for high-flying action, and other things the gunner must know.

Then the student moves to the firing range and discovers that what he always has regarded as a sport—skeet shooting—is a vital part of his training course. First he tries his skill at the skeet stand, firing his shotgun at clay pigeons tossed into the air; next he sits in a truck moving about 25 miles an hour and shoots at clay pigeons thrown from traps as the truck moves along the road. Thus he begins to learn how to hit a moving target.

Somewhere along the line, he enjoys a short session of shooting gallery training, firing a .22 caliber rifle and then a BB machine gun at small moving targets.

Now comes more serious work with the .30- and .50-caliber machine guns he will use against enemy fighters. First, our student fires at fixed targets on the range, then at moving targets.

Among the targets at the flexible gunnery school is a miniature plane bearing German markings. Mounted on top of an armored jeep, it travels around a circular track at about 35 miles an hour, affording shots from all angles, with the range varying from 10 to 400 yards. This training will come in handy when he may be firing at an enemy aircraft while his own airplane flies upside down or while banking steeply.

Now comes firing at similar targets from turrets, like those in the aircraft in which he will see action. This accustoms him to the space in which he must operate his weapon while following the twisting, dodging enemy aircraft through his gun sights. Now the student is ready for firing in the air—shooting from a machine gun turret at a sleeve target, a long, white cylinder towed by another airplane. All the bullets that he fires are of a particular color, having been dipped in paint to identify his hits. Eight gunners, firing different colored bullets, shoot at the same sleeve target.

Finally, the student discards the machine gun for a camera gun and learns to draw a bead on attacking fighter airplanes as they

(Continued to page 150)

THIS IS A NUT... but

It looks much like any other nut, except for a "locking ring" of elastic material inserted in its top.

It fits any standard bolt.

It goes on like any other nut, except that it is wrenched on instead of being spun on with the fingers.

But it is unlike any nut you have known in the past because:

When it goes on it stays on.

In spite of vibration, stress, strain, this Elastic Stop Nut will not loosen, slip or break.

It may be removed as needed—and still locks itself tight when put back.

It *licks* vibration.

And not a single one has ever failed in service, to our knowledge, though our total production now adds up to billions.



Coal stokers have many moving parts where the tight grip of Elastic Stop Nuts can prevent service interruptions.



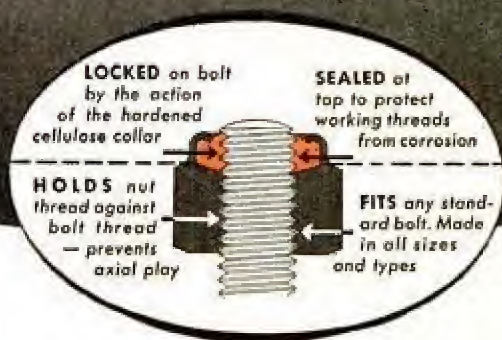
Sonny's tricycle will need less "fixing" by Dad with non-loosening Elastic Stop Nuts replacing the usual kind.



When regular nuts loosen, cars squeak. So look ahead to quieter automobiles after victory is won.



Garden tools will stay set and snug without constant tightening with Elastic Stop Nuts holding them.



ELASTIC STOP NUTS

Lock fast to make things last



ELASTIC STOP NUT CORPORATION OF AMERICA
UNION, NEW JERSEY

Flaming Filings for "der Führer"



FEARSOME is the fury of an incendiary bomb—as Berlin knows and Tokyo soon may learn. Its fiery element is *magnesium reduced to powder form*.

Strangely, the best way to produce these granules in proper consistency was found to be through *filings* made from solid bars of magnesium.

With the knowledge from 79 years' experience, Nicholson designed and now manufactures a special machine-operated rasp that *does the job*.

What's the work, what's the material and what's the finish? . . . Whatever the filing operation or problem, Nicholson can provide *The right file for the job*. More than 3000 kinds, cuts and sizes of files in the Nicholson, Black Diamond and associated lines are evidence that proper filing and file-making are almost endless in their requirements.

FREE — NEW BOOK, "FILE PHILOSOPHY." Invaluable to production heads, foremen, key mechanics . . . 48 interesting pages—highlighted with information on proper use, care and selection of files; on special files for soft metals, stainless and other steels, plastics, foundry and die castings, lathe filing, etc.

NICHOLSON FILE CO., 22 Acorn St., Providence, R. I., U. S. A.

(Also Canadian Plant, Port Hope, Ont.)

NICHOLSON
FILES FOR EVERY
PURPOSE

NICHOLSON
U.S.A.
MADE IN U.S.A.

dive and twist. The camera gun catches a picture of the attackers, which shows whether the gunner is accurate or not.

That completes the course and the student is ready to become a member of a bomber crew and take up combat training; later comes a course in fire control.

Out in the field our graduate may be called upon to man the gun at several places in a big bomber, perhaps the "stinger" in the tail, the top turret or the "duster" in the belly of the aircraft. The stinger and the duster have been surprise packages for Axis aircraft. Zeros and Messerschmitts approaching American bombers from the rear and from below have run into a hail of bullets from the guns at these two points. The position of gunners at either location is anything but comfortable. Of the two, the duster is probably the toughest, since the gunner must curl up inside the cramped space of his "blister" below the fuselage. But the results obtained by gunners at these two points have made the discomfort endurable.

The bomber's crew works like a well-drilled football team. The navigator lays out the course and the pilot flies the ship on that course. The radio operator maintains communication with other bombers of the squadron and with bases. The engineer keeps the motors and other equipment in operating condition; the bombardier is responsible for dropping the bombs accurately and for manning the machine guns in the nose of the airplane. The gunners in the bomber handle the stinger, the duster and the upper turret; the radio operator and the engineer fire side guns if enemy fighters attack.

Upon the skill and courage of all these gunners depends the safety of the bomber and its crew when bullets start spewing.

Plant Food Is Glued to Seeds To Aid Their Germination

Garden seeds that carry their own food into the ground are possible under an invention of Albert C. Fischer of Chicago. Each seed is coated with a water-soluble glue into which the initial life-needs of the seedling are impregnated—a small provision of fertilizer, fungicide, insecticide and in the case of legumes, nitrogen-fixing bacteria that the seed will need in the first day or so after germination. To protect seeds against possible ill effects of too-long contact with fertilizer and fungicidal compounds they are first coated with a neutral glue, then with one or more coats of the fortified glue.

pat. # 2,313,057

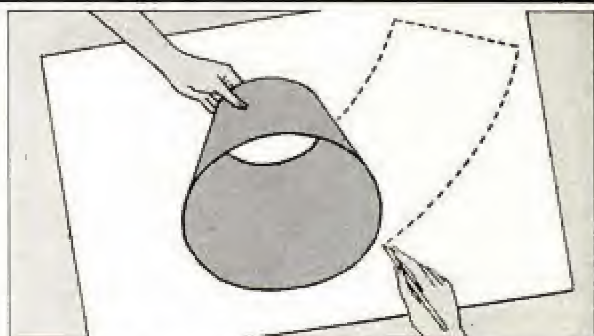
POPULAR MECHANICS

HOW TO GET ADDED LIGHT from the SAME lamps

Helpful wartime suggestions from General Electric



You can add light with soap and water! Wash bulbs (unlighted) and reflector bowls of reading lamps and you'll increase light 25% to 30%. Cleaning steps up industrial lighting, too.



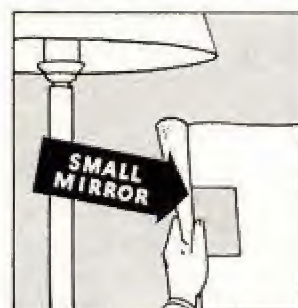
Light linings in lamp shades can double your light. To reline parchment shades, roll shade on white paper and pencil a mark to cut. Fasten in with scotch tape.



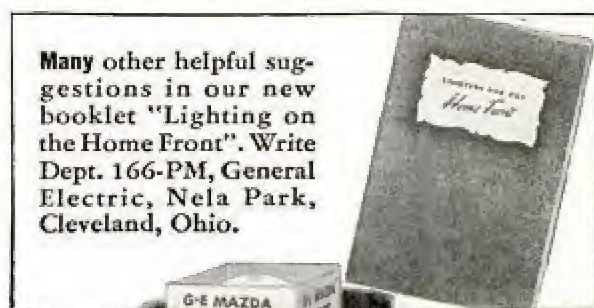
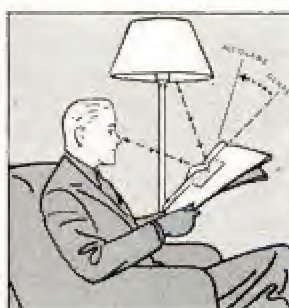
Arrange lamps and furniture so each lamp can, if necessary, serve two or more people. By letting lamps do double duty, you conserve light and sight.



Sit close enough. Move your lamp nearer and get more help from it. A few inches farther away can mean 50% less light. But be sure shades are deep.



Avoid reflected glare from shiny pages. It's the tilt of your page that does it. Try holding a small mirror on page. Then tilt until you can no longer see the lighted bulbs or bowl.



Many other helpful suggestions in our new booklet "Lighting on the Home Front". Write Dept. 166-PM, General Electric, Nela Park, Cleveland, Ohio.

Made to Stay Brighter Longer

G-E MAZDA LAMPS
GENERAL  ELECTRIC





Someday we'll be ready for this fellow

There's no telling just when, but p'raps about the time your pup is a grown dog trained for the field, there'll come a day when he'll stand alert at the door. He'll look at you, impatient and wondering. You'll say, "All right, fellow. Let's go!" And you'll take out your brand new H&R shotgun . . . the gun you had always dreamed of—well-balanced, beautifully finished, a top-notch performer in every way . . . and just as eager and alive as the hound, you'll set out into the open . . .

RIGHT NOW, Harrington & Richardson is busy with the manufacture of war weapons. The sporting gun craftsmanship that we built up for 70 years is now used to good advantage in making the famous H&R Reising Submachine Gun.

BUT WHEN THE WAR IS WON, H&R will be back in the sporting arms field with amazing new guns. We can't give you details now . . . but we know you'll want one; it will be fashioned with skill from new steels, new plastics, new alloys. It's one part of the glorious American future that's worth waiting for, working for, saving for, fighting for.

HARRINGTON & RICHARDSON

FREE TO GUN FANS

Every man and boy who loves firearms will enjoy the detailed, illustrated H&R Reising Submachine Gun Manual. It's free . . . use the coupon.



Harrington & Richardson Arms Co., Dept. PM-1
Worcester, Mass.

Send my free copy of the H&R Submachine
Gun Manual.

Name.....

Address.....

Old Man River Gets in the Fight

(Continued from page 54)

tons of coal down to Pittsburgh in 1941.

Barges travel by the clock. On regular schedules the "trains" of Union Barge Lines shove out into the stream from Houston and New Orleans and Pittsburgh freight terminals. Telegraphic reports tell the exact location of the boat, the size and nature of the tow, and a dispatcher at the home office plots the information on a master board along with tabs showing barges awaiting pickup at various landings. It's eight or nine days from Pittsburgh to Memphis, 1,208 miles away; 14 days to New Orleans, 1,956 miles down river; three more days to Houston, 409 miles farther. Upstream it's slower. However, in recent years Union's affiliate, the Dravo Corporation, has developed towboats especially designed for propulsion against the current, using the Kort Nozzle, a tubular sheath which encircles the propeller and leads the water to and away from the screws. This harnessed the thrust of the blades most efficiently.

The stern wheelers have not vanished. Steam-driven paddles still churn up and down the rivers but twin-screw Diesels are crowding them out. One of the biggest towboats in the valley is the Anker L. Christy of the Pure Oil Company fleet, a triple-screw vessel with three 400-horsepower Diesels. Her regular chore is to push 1,344,000 gallons of gasoline in two barges—590 feet from nose to rudder—from Port Neches, Tex., to Minneapolis. Behind her big rubber-faced towing knees is a luxurious cabin topped by a pilot house that retracts hydraulically into the deck to duck under low bridges. Like the instruments in a sky liner, its control panel is illuminated by ultraviolet rays; it has a central communicating system and ship-to-shore radio telephone. A single lever in the pilot house controls all engine and rudder movements.

If Old Man River would lie still, life would be a lot simpler for the pilots. But the old man keeps squirming in his bed, shifting around, and army engineers are forever straightening him out. A pilot must know the profile of the river as he knows his own wife's. He must know every light and bridge and landing. Like the air pilot, he will be tuning in for the latest reports of river conditions and obstacles to navigation, and he'll be taking down orders from the home office to pick up a barge at the next port. Which is not so quickly done as said. Deck hands may have to row

(Continued on page 154)

SENTRIES

On Motorized Life Lines



TANK OIL FILTER PANEL—built by AC since Pearl Harbor



AUTOMOTIVE OIL FILTER—built by AC since 1926.



THERE is nothing heroic about that battery of oil filters clamped against the engines of General Sherman tanks. But, without them—standing constant guard against dirt in lubricating and fuel oil—those engines would shortly be wrecked.

Except for size and certain details, these Army AC Oil Filters are identical with those which have kept engine and fuel oil clean, for years, for millions of American motorists. Both are scientifically engineered. Both are precision built. Army mechanics and tank crews know filters *must* be kept functioning. So, elements are changed in strict accordance with Army procedure.

Your engines, too, need oil filter pro-

tection; the element should be replaced regularly.

Conservation is the order of today. And it is easy to get through the service which America's mechanics are now rendering. This is being augmented by contacts from AC, carrying to all service organizations the latest and most practical methods of diagnosis and repair for AC products. Details of this Service are given in the panel below.

When replacement is needed, select AC—and be sure of complete satisfaction.



Awarded to the men and women of AC on September 2, 1942, for outstanding achievement in producing for Victory.

AC SPARK PLUG DIVISION
GENERAL MOTORS CORPORATION

OIL FILTERS—Slow driving accelerates the formation of soot and carbon in engine oil. If not constantly filtered from the oil, this dirt will clog piston rings, which causes increased consumption of oil and gas. So, replace your oil filter element whenever your dealer's AC Oil Test Pad shows that your oil is dirty.



SPARK PLUGS—Dirty or worn plugs waste as much gas as one coupon in ten. They also cause hard starting which weakens your battery. Under present slow driving conditions, have your plugs cleaned and adjusted every few months.



AIR CLEANERS—A dirty air cleaner increases gasoline consumption because it chokes down the flow of air into the carburetor. Your air cleaner should be rinsed whenever your car is lubricated.



FUEL PUMPS—Practically trouble free. But, if yours has been in use thirty or forty thousand

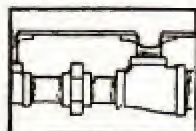
miles, it may be worn to the point where a check-up is due.



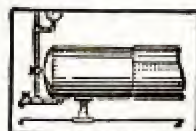
DRIVING INSTRUMENTS—Speedometer, gasoline gauge, oil pressure gauge, ammeter, and temperature gauge seldom need service. But, if they give trouble, have them cared for at once.

BRING VICTORY QUICKER—BUY U. S. WAR SAVINGS STAMPS AND BONDS

IT'S EASY to make war-time repairs with SMOOTH-ON



Pipe Leaks



Tank Leaks



Radiator Leaks



Fire Pot Leaks



Leaky Kettle

Don't worry because you can't replace damaged household equipment during the war. You can stop leaks, seal cracks and tighten loose parts with SMOOTH-ON No. 1, the many-purpose iron cement. No need to dismantle piping or apparatus, or to send for a professional repair man, because SMOOTH-ON is easy to apply and requires no previous experience.

Be sure to buy a can of SMOOTH-ON without delay, and keep it handy for emergencies. SMOOTH-ON comes in 1 $\frac{3}{4}$ -oz., 7-oz. and larger containers, and you can get it at your hardware store, or if necessary, from us. For your protection, insist on SMOOTH-ON—used by mechanics and repair men for 48 years.

FREE BOOK

Get your copy of our latest 40 page illustrated handbook. Shows how to make repairs quickly, economically. Just send the coupon.

Smooth-On Manufacturing Co., Dept. 37
570 Communipaw Ave., Jersey City, N. J.
Please send the FREE Smooth-On Handbook.

Name.....

Address.....

6-43.....

MAIL IT
TODAY

Do it with SMOOTH-ON

ashore with a mooring line to "choke" around a cottonwood tree, and it may take an hour to ease the 10,000-ton load up to the dock and lash the new barge fast. Before docking the captain had figured how to balance his load by playing "checkers" with tiny wooden templates, arranging and rearranging the miniature barge models for best weight distribution. At intervals along the river a deck hand will drop the weighted "lead line" and call off the channel depth to the pilot—"quarter less twain—mark twain (twelve feet)—quarter twain"; and in port he'll drop a gauge pole overside to measure how much water each barge is drawing, which shows the loaded weight of the barge.

Later in the day the pilot may spend most of another hour jockeying his lanky tow around a tricky bend where hungry sand bars reach out to grab him. Multiple rudders ease this chore somewhat by giving the modern towboat maximum maneuverability. The Dravo-built "William Penn," for example, has two rudders ahead and one aft of each of the twin seven-foot propellers, permitting it to right-about-face in not much more than its own length, whether moving forward or backward. The six-rudder gear is hydraulically operated, controlled by a steering bar which indicates the angle of the rudders, rather than by a wheel.

Besides its mechanical marvels, the 1943 towboat offers more than the comforts of home; air-conditioned rooms with bath for officers and guests, insulated walls, luxurious leather-covered furniture in cabins tastefully planned by interior decorators, loudspeaker systems and two-way radio, filters to purify river water, lifeboats and power tender, sun deck, laundry, electric dishwasher and range in a galley any housewife would envy.

Not all of them are so fancy; the fanciest is none the less a worker. Towboats shoved over a hundred million tons of cargo along Uncle Sam's waterways in a year, and that's close to 5,500 fifty-ton freight-car loads delivered every day of the year. Life on the Mississippi may be less picturesque than in showboat days, but it's bustling. Old Man River keeps rolling up his sleeves.

Steel Tonnage in U. S. Hits Peak

Steel production in the United States for 1943 is estimated at 93,000,000 tons. In 1940, the last year for which accurate worldwide data are known, we produced 66,982,686 tons, Russia 21,800,000, United Kingdom 15,000,000, Canada 2,173,887, against 43,445,000 tons in Nazi and occupied Europe and 7,100,000 tons in Japan.

Automotive
POPULAR MECHANICS
Industries Mar 15-43



Vital GUNS to all Corners of the Earth

As in 1917, our technical skill and large production capacity are devoted to the cause of winning a war.

Vast quantities of precision-built Browning machine guns are pouring forth to arm the rapidly growing fleets of bomber and fighter planes that are now attacking and bewildering the enemy in all corners of the globe.

Thompson submachine guns and military rifles are coming in continuous streams from round-the-clock production lines . . . vital equipment for Allied forces everywhere.

From such resources comes victory. And, after that, assurance of new and improved sporting arms, in ample supply.

Savage Arms Corporation
Utica, N. Y.



"Proudly we hail—"

"SAVAGE" was among the first to receive the Army-Navy "E" for high achievement in war production. Proudly the cherished pennant flies above our Utica plant proclaiming, "Well done—DO MORE!"

SAVAGE



**SAVAGE
AUTOMATIC SHOTGUNS**
Will resume their steady rise in popularity which, before the war, culminated in the introduction of the lightweight model for upland hunting.



DO YOU THINK IN CIRCLES?

Do you ask yourself, "How shall I begin; what shall I do next?" Have you a confusion of ideas? Mastery in life, success in any enterprise, comes from the subtle ability to marshal your thoughts, to call to the fore, when an emergency arises, the proper mental powers. Mentally, you are an aggregate of forces. Why dissipate them because of lack of knowledge of how to properly use them? Learn to unite them, and you will have at your command, a *tremendous power* for accomplishment.

SEND FOR FREE BOOK

The Rosicrucians have preserved for centuries knowledge of the secret method for the development of mind power and the direction of man's unused inner faculties. This wisdom, not strange or mysterious, has changed the course of life for many men and women throughout the world. Write for the free, sealed book which explains how you may obtain this helpful information. Address: Scribe X. J. Z.

The ROSICRUCIANS

[AMORC]

San Jose

California

— USE THIS COUPON —

Scribe X. J. Z.

The Rosicrucians

San Jose, California

I am sincerely interested in an intelligent method for attaining a mastership of life. Send me without obligation, your **FREE** Book which explains how I may receive and use your age-old method.

Name.....

Address.....

City.....

Sea-Going Shutterbugs

(Continued from page 25)

At Pensacola Naval Air Station, Florida, the Navy has a school of photography which each month graduates 100 officers and men trained in all phases of photography—aerial, sea, and land. The graduates of this school, and many other excellent photographers recruited from the civilian field, took the striking photographs of the battles of the Coral Sea, Midway, the sinking of the U.S.S. Lexington, the Japanese raid on Dutch Harbor, and the American raid on Japanese transports at Kiska.

The school trains the student to cover any navy photographic assignment, anywhere, at any time and under any conditions. Once the student completes the course he is qualified to go out to the fleet, and, with a thorough knowledge of all navy photographic equipment, to cover any assignment and if necessary set up and operate a complete photographic laboratory.

Today the school is the largest school of naval photography in the world, occupying its own building with more than 10,000 square feet of floor space and an estimated \$250,000 worth of equipment. Included in the extensive layout are 10 double negative darkrooms for primary work, a large darkroom with 30 contact printers, another with 30 enlargers, elaborate drying and finishing rooms with the most up-to-date equipment, a larger aerial assembly room and another for movie assembly, and aerial and movie printing and developing rooms. In addition, there are two classrooms seating 80 students each and another, complete with movie projection room and screen, to accommodate 120.

Ten planes from the station are assigned to the exclusive use of the school and the station photographic laboratory with special pilots long trained in aerial photography at the controls.

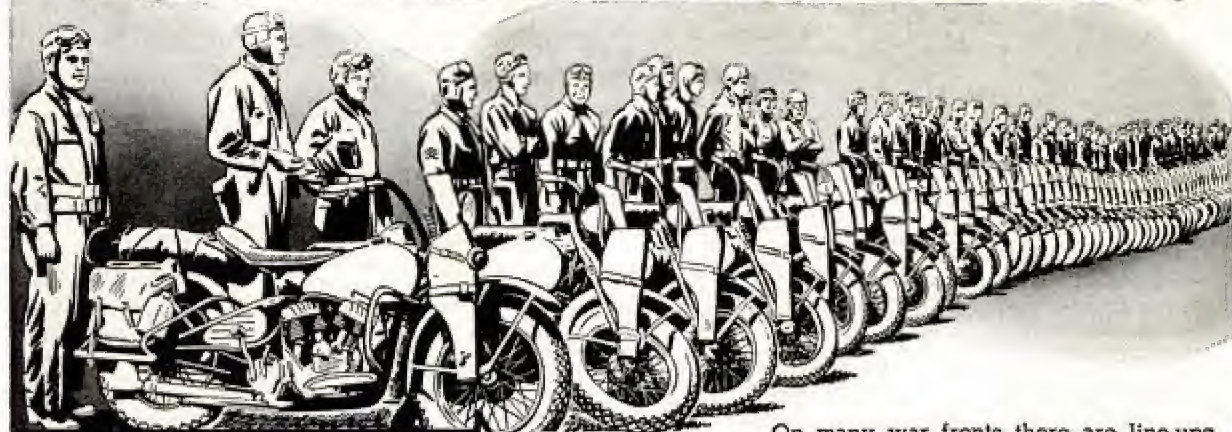
The training course is divided into four phases—primary basic, advanced basic, aerial and movie photography.

Upon his arrival at the school the student is given a course in optics and the chemistry of photography, and then learns the handling of the elementary camera and darkroom technique in printing and developing. Thus indoctrinated the student enters the advanced basic phase to take up the photography of colored objects, enlarging and copying and intensification and reduction.

In the third class the student learns the art of aerial photography. Here he spends nearly half the class time in a plane high

(Continued to page 159)

For Future RELIABILITY RUNS!



Write today for your FREE copy of "Enthusiast" magazine, filled with motorcycle action pictures and thrilling stories.

HARLEY-DAVIDSON
MOTORCYCLES



On many war fronts there are line-ups like this — that remind every motorcycle enthusiast of glorious days to come. Then once again there will be exciting trophy runs, hillclimbs, gypsy tours, race meets and other thrill-packed motorcycling events. Yes, and war-proved Harley-Davidsons with greater stamina and rugged dependability! Buy War Bonds now—and ride a Harley-Davidson after "the boys come home!"

HARLEY-DAVIDSON MOTOR CO.
Department P MILWAUKEE, WIS.



A Tribute... and A Responsibility

When the men and women of Stanley Tools, Division of The Stanley Works, received the Army-Navy "E" award on February 13, it was a much prized tribute to a great production team. Of particular interest is the fact that it came during the one hundredth anniversary year of the Company.

Upon their shoulders has rested a triple burden. They have been called upon to supply (1) tools for the armed forces... to construct and maintain camps, bases, and barracks; (2) tools for war industry... to build plants, ships, planes, and other implements of war; (3) tools for the home front... to maintain farms, schools, institutions, and essential civilian industries.

Hand in hand with this honor for past performance goes a great responsibility for future performance. These men and women fully realize this responsibility. Far from being contented with the "contribution to Victory" already made, they are striving to make a greater contribution in the future. Stanley Tools, Div. of The Stanley Works, New Britain, Conn.

1843 **STANLEY** 1943

POWER Is Vital to Victory...

● Power is an important factor to the successful operation of every branch of our armed forces. It is vital to victory in a thousand and one ways—destructive firing power on the front lines—essential auxiliary power behind the lines!

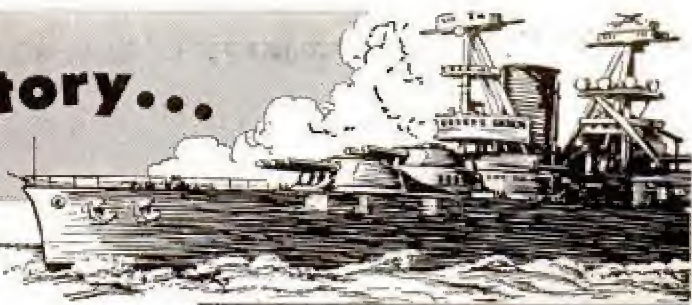
WITTE Power Units Also Serve—WITTE Diesel Engines and Dieselectric Plants are serving our fighting forces in Africa, Alaska, the South Pacific area, the Panama Canal Zone—and many other places where auxiliary power and light, or a vital water supply may be needed.

Now WITTE devotes its complete facilities to the urgent task of producing for the war effort. After victory, efficient, economical, expertly engineered WITTE Diesel Engines and Dieselectric Plants will again be available for all. *WITTE has served the world for 73 years*—will continue to serve during the great peacetime future.

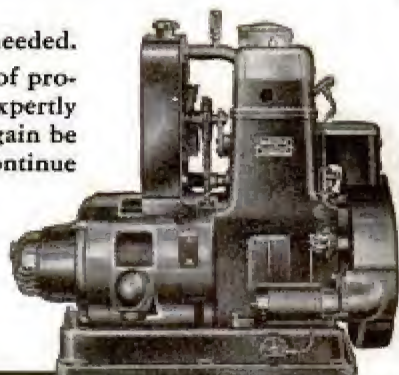
WITTE ENGINE WORKS

LARGEST BUILDER OF SMALL DIESELS

KANSAS CITY, MO., U.S.A.—Cable Address: "WITTEKCMO"



WITTE
DIESEL ENGINES and
DIESELECTRIC PLANTS



Ta-pat-co SLEEPING BAGS ARE BEDDING DOWN SOLDIERS!

If you have missed finding your Ta-pat-co sleeping bag, life preserver or other outdoor sports equipment at your sporting goods store, you know that it is somewhere helping a soldier. Ta-pat-co sports equipment is now Ta-pat-co FIGHTING equipment—contributing to the comfort and safety of our army, navy, marines and air corps. Our factories, materials and every facility at our command has been given over to meeting war requirements.

Keep in touch with your sporting goods dealer; he will be first to know when Ta-pat-co equipment is again available for your outdoor sports enjoyment.

1-S-3

Ta-pat-co

OUTDOOR ~~SPORTS~~ EQUIPMENT
FIGHTING

American Pad and Textile Co., Greenfield, Ohio

Say you saw it in *Popular Mechanics*!

Wherever THE ARMY GOES

★ **HULL STREAMLINE COMPASSES**
are being made exclusively for use on U. S. Army vehicles—where they contribute to the efficiency of our armed forces. Wartime engineering improvements assure an even more dependable guide for motorists after the war.



HULL MFG. CO.
P. O. Box 246-D6, WARREN, OHIO

Keep car radiators cleaned out for greatest motor efficiency. Use

Sani-Flush 10c and 25c sizes
Directions on can

The Dennison Handy Helper says:
"WRAP IT TIGHT—MARK IT RIGHT"

Dennison
MAILING LABELS

Transparent Mending Tape • Crepe Paper
Gummed Reinforcements • PRES-a-ply Labels
Index Tabs • Shipping Tags • Gummed Labels
DENNISON MFG. CO., Framingham, Mass.



above the coastline of the Gulf of Mexico, receiving instruction and practice in map making, obliques and stereos. The last phase takes up motion pictures, with each student making, developing, printing, editing and projecting his own 35 mm. film.

Upon graduation from the school the student may be assigned to a photographic laboratory at one of the shore stations or may go directly to the fleet. At a shore station he will be called upon to cover routine construction and repair; identification of personnel; new equipment; damage to equipment and parts; copies of drawings and charts; athletic teams and events; station operations; damage due to natural causes, and a wide variety of subjects covered by aerial photography.

The photographer afloat will, in addition, be called upon for aerial and ground photography of friendly and enemy vessels; the enemy fleet and its units; fleet engagements; operations against an enemy coast; landing force operations; damaged vessels and aircraft, and many special missions.

And one of these special missions may include the manning of a gun. Whether they are tripping camera shutters, or pulling triggers, Uncle Sam's new seagoing shutterbugs can be depended on for accurate aim.

Paper Is Made Water Repellent By Mysterious Vapor Film

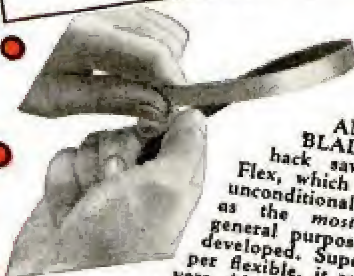
Paper, cloth and other materials are provided with an "invisible raincoat," whose exact nature is not known even to the General Electric chemist who devised the procedure, by exposure to chemical vapors. Various chemicals are used, among them being methyl chlor silanes. Articles to be treated are exposed to such vapors for a few minutes in a closed chamber, and there results an extremely thin film which resists wetting. Because of its thinness, neither chemical analysis nor microscopic examination has been able to ascertain the true nature of the film. Such a treatment is given ceramic insulators for military radio equipment, which formerly lost much of their electrical resistance when exposed to high humidity because thin films of moisture forming on their surface allowed current to leak away. With the treatment, if moisture collects on the insulators it is in the form of widely separated drops that do not allow electricity to pass.

With about 800 bundles of nerve fibers, the optic nerve is like a telephone cable, connecting the human eye with the brain.

KNOW YOUR TOOLS

by MILLERS FALLS

31 RATCHET BRACES make up the standard Millers Falls line, ranging in sweep from 6 to 14 inches (sweep: radius of handle action to the more sweep, the more leverage), in finishes from simple polish to chromium plate, in bearings from simple ball to oil-impregnated. Each fills its special need, each is a Millers Falls quality tool, designed and produced with the benefit of all we've learned in 75 years of fine tool making.



AN AMAZING BLADE for hand back sawing is Tuff-Flex, which Millers Falls unconditionally guarantees as the most economical general purpose blade ever developed. Super-tough, ever flexible, it withstands severe side strains, takes a 270° bend without breaking, cuts thin sheets and hardest drill rod with equal ease. Eleven sizes cover every hand sawing need. Characteristic Millers Falls quality.



AMONG THE 14 high-production portable electric screwdrivers and nut runners in the present Millers Falls line is the "Dyno-Mite," a wonderfully light and powerful tool with the famous "Adjustomatic" clutch, which disengages when pre-selected screw or nut tension is reached. Easily controlled with one hand in awkward corners; smooth, near-vibrationless, trouble-free. Available with 90° or 25° angle drives; stand converts "Dyno-Mite" into convenient bench unit of high-speed assembly.

MILLERS FALLS TOOLS

SINCE 1868

MILLERS FALLS COMPANY

Greenfield, Mass. U.S.A.

"YANKEE" TOOLS

GET THE MOST OUT OF RATIONED TIME



A half-century before death rained from the skies over Pearl Harbor, "Yankee" Tools were putting extra minutes, saved seconds, into the hands of skilled mechanics everywhere. Now, when time is of the essence, "Yankee" Tools continue to speed production, to salvage that remnant of time left to America in which to deliver the knock-out blow. . . . The war we didn't want will be behind us one day, and "Yankee" Fine Mechanics' Tools will have had a part in putting it there. In the meantime, give America, and all America means to you, your best.

"YANKEE" SPIRALS

SIMPLE • COMPACT • STRONG



A SIZE FOR EVERY PURPOSE

"YANKEE" TOOLS

make good mechanics better
North Bros. Mfg. Co., Phila., U. S. A.
Established 1880

Makers, also, of "Yankee-Handyman" Tools



VALUABLE TOOLS

need adequate protection. Free Catalog to toolmakers and machinists.

GERSTNER TOOL CHESTS

443 Columbia St. Dayton, Ohio

To every man who expects to join the Armed Services

(See Inside Back Cover)



Today, 100% in war work. In normal times, manufacturers of 22 cal. RIFLES, SHOTGUNS, TELESCOPE SIGHTS, TARGO GUNS & EQUIPMENT

Soda Pop to the Rescue

(Continued from page 60)

trucks" which operate on hundreds of American airports. These have saved many lives by nipping a fire seconds after it has attacked a cracked-up plane.

Another portable type, for use in war-time industrial plants, is a trailer which may be hooked to any auto available, and rushed to the scene of a fire. This equipment carries half a dozen large tanks of carbon dioxide, valves and a hose to put out a fire by the soda pop method.

Carbon dioxide has existed since the beginning of the world, but it was not until the 18th century that mankind learned of it. Joseph Priestly, an Englishman interested in chemistry, happened to live next door to a brewery. Curious about the bubbles which arose from the brewery mash, he trapped enough gas to find out what it was and eventually brought his secret to the United States where he induced a druggist to serve sweet flavoring in water charged with the gas. Thus the soft drink industry started.

The second step in the advancement of CO₂ was taken by accident. A Swedish harbormaster set up a winking buoy with the flash device controlled by the discharge of compressed carbon dioxide released at regular intervals. The flame was wind-proof, but when he examined the buoy one morning, the flame had been extinguished, the story goes. He also found a leaky valve in the winking gadget. Adding up the two facts, he decided soda pop gas could be used to put out other flames.

Walter Kidde and Company, a concern which has pioneered in new uses for carbon dioxide, began developing uses of the gas to fight fires. Meanwhile, the concern's engineers were experimenting with many other possibilities, so that when the war started they were also ready with inflation and activating devices.

One of the latest additions to the long list of improvements added by this company is a shatterproof steel bottle especially for warplanes. In the past many fliers were killed when a bullet or shell fragment hit the bottle, the gas exploding under pressure converting the bottle into a bomb. The bullet may penetrate the new bottle, but the bottle will not shatter.

So the same soda pop gas that gives you the pleasant sensation when you take a swig of your favorite soft drink has given a much more pleasant sensation to many a brave American fighting man, faced with sure death if carbon dioxide were not readily at hand to rescue him.

EVINRUDE POWER for Swift Storm Boats



"Storm Boats" they're called . . . these slashing little hurricanes of power and speed. They can float in mere inches of water. They can weave, twist, dart like furious hornets. And they can whisk a landing force to a beach in a breath-taking hurry!

Motors for the Storm Boats . . . motors jam-packed with power and stamina . . . the assignment to build them was given to Evinrude. Years of experience building great racing Evinrudes, mightiest of outboards, gave quick answer to every requirement of speed and ruggedness and "fighting heart". Down the production lines they came . . . dynamic "storms" of eager power to drive the fleets of Storm Boats!

Giving top speed to assault craft . . . driving heavily laden barges and lighters . . . capably powering small boats of every type . . . Evinrude motors are serving on many fronts! Building for Victory is our sole job now . . . with peace, there will be brilliant new Evinrudes for happy days on the water again.

EVINRUDE MOTORS, Milwaukee, Wisconsin
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EVINRUDE OUTBOARD MOTORS

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KEEP 'EM FIRING

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WAR BONDS

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In the battle behind the lines you'll find Atlas "artillery" heavy favorites on air fields, in shipyards, and in most of the nation's key industrial war plants. Atlas Lathes, Milling Machines, Shapers, and Drill Presses are proving throughout the world the value of using modern, compact, fast precision machine tools for all small-parts production. Remember — after the war — that Atlas precision and rugged strength have been proven in the toughest test of the ages. Atlas Press Company, 643 N. Pitcher St. Kalamazoo, Mich.

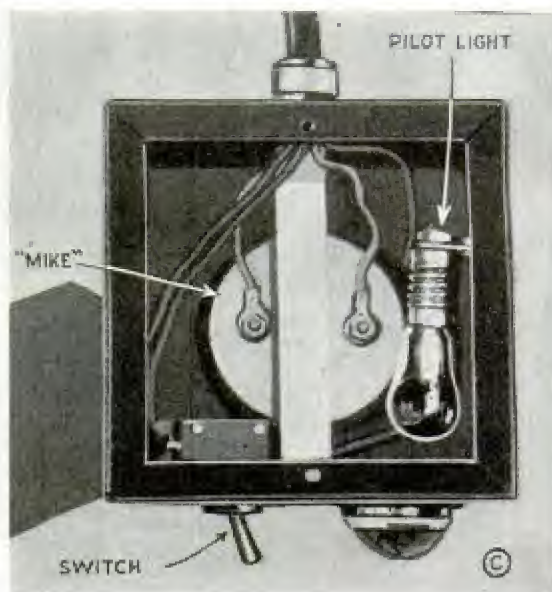


VICTORY FIRST! — THEN Atlas TOOLS FOR YOU

New Uses for Phono Oscillators

(Continued from page 144)

the distance between the radio receiver and the phono oscillator is too great for



strong signals it may be necessary to use a short antenna wire. The oscillator can be turned on and off by means of the toggle switch on the pickup box.

Running Down Hum Bugs

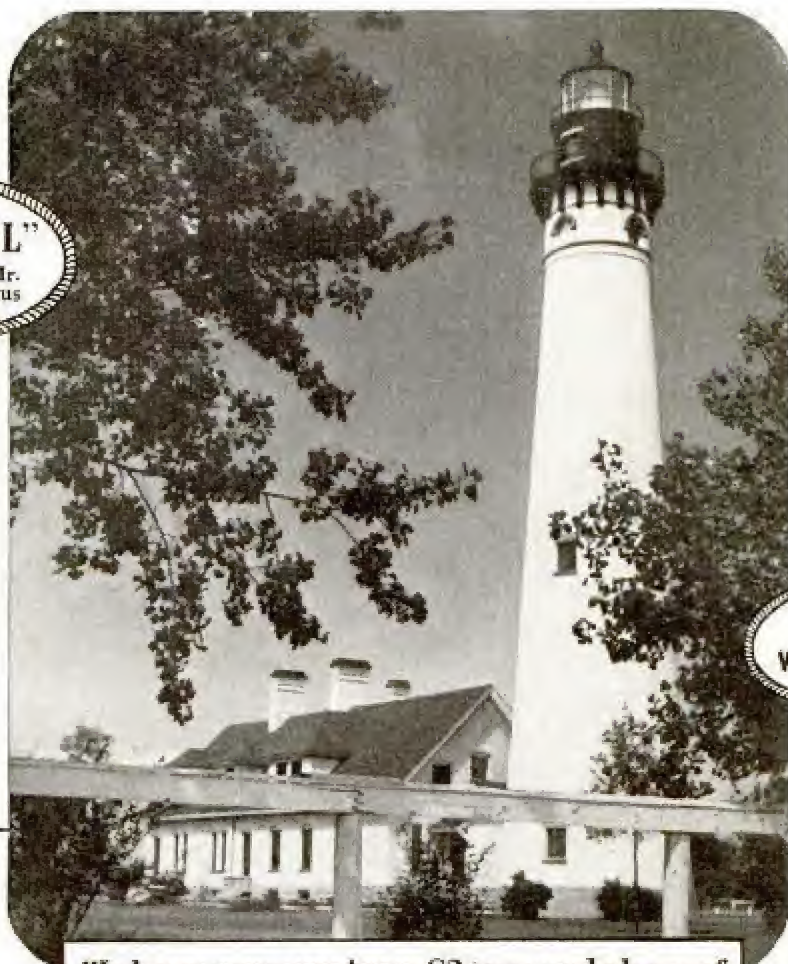
(Continued from page 141)

trolitic. These decoupling filters reduce hum and prevent stray r.f. from creeping in through B positive and C-bias leads.

In the small inexpensive receivers of the a.c.-d.c. variety, hum usually originates in the power supply. Electrolytic filter condensers of too little capacity and filter chokes of miniature size, cause ripple voltage high enough to produce objectionable audio hum in the speaker. If filter condensers of larger capacity are not immediately available, experimenters often connect a .1 mfd. 400-volt tubular paper type condenser from one side of the 110-volt line in the set to the chassis. If a condenser of that type is already in this position, try another of the same value from the other side of the line to the chassis. Sometimes merely reversing the heater connections to the first audio tube will greatly reduce a high hum level. If hum output varies with the position of the volume control, test the tube that is connected to it for heater-cathode leakage. Have this done by your local radio serviceman if possible, as ordinary routine tube tests do not always indicate this fault.

"SENTINEL"

from one of Mr.
Pedersen's Argus
negatives.



**BUY
WAR BONDS**

"I always carry my Argus C2 to record places of
interest," says Ed J. Pedersen of Preston, Minn.



IN a little over a year, Mr. Pedersen has made nearly a thousand pictures with his Argus, and says, in part, "I have no trouble obtaining good results in both black and white and Kodachrome, thanks to the accuracy of the Argus C2 shutter and coupled range finder." His Argus Cintar F 3.5 lens serves double duty, since it is easily removed from the camera for use on his enlarger.

Perhaps your Argus dealer can still show you this versatile picture-maker.

TECHNICAL DATA

Camera: Argus C2

Film: Plus X

Apertures: F:11

Exposures: 1/100

Filters: 2X Yellow

Developer: DK20

argus
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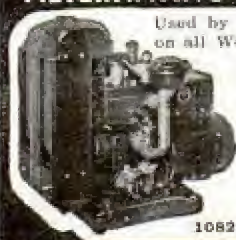
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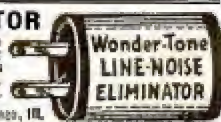


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ALBERT CONSTANTINE & SON, INC.
791-K East 135th St. New York, N. Y.

Falling Dynamite

(Continued from page 15)

"on the double." He double-times to chow and to classes; he double-times for a drink of water. A Paramarine rarely walks.

Whipped into top condition by calisthenics and tumbling, he graduates to the first jumping tower. In a controlled fall from this 250-foot tower, the Paramarine becomes accustomed to the jolt of the opening parachute, then goes to the free chute tower. Here he is raised to the top of the tower in an open chute and released.

He gets the feel of the free fall and learns to manipulate the lines to control his landings. Repeated practice jumps instill confidence in the silken umbrella on which his life depends. The student learns to pack his own chute, placing on his own shoulders the responsibility for his own safety.

Hardened and confident after these weeks of instruction, the student is set for the big moment—the first leap from a plane. This is it. No second-guessing here.

Up in the big twin-motored plane ten pairs of sturdy legs feel a bit weak. Legs which can run for miles and stand the shock of jumping from high ledges have to be urged toward the door.

But when the time comes, there is no hesitation. Out of the plane they pour, diving headfirst into space. Once the chute snaps open the men float down singing, yelling at each other. In a matter of seconds they hit the ground, rolling and tumbling to absorb the jar. It is all over almost before they realize what has happened. But they have learned their lessons well; there are no injuries. That wasn't so bad!

Ask any Paramarine which jump was the hardest, and almost invariably he will say the third. The first time you don't know what to expect; the second time you try to analyze things, the third jump you know just about what's going to happen and you tighten up, bracing for the worst.

After the first leap, the student has five more jumps from the plane and one night jump from the tower before he wins the curled wings of the Marine Paratrooper.

Organized at Lakehurst, N. J., in January, 1941, the school was moved to San Diego in May, 1942, with Lt. Col. Shepard as commanding officer, and was transferred to its present location in August.

A compact striking force, the Paramarines have doctors and hospital corpsmen who jump with the men. From buck privates to the colonel, every man is a qualified parachutist. And when they strike from the clouds they live up to their nickname—"Falling Dynamite!"

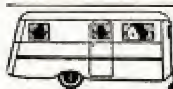
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REPAIR THEM WITH RUTLAND PATCHING PLASTER

says Uncle Ned,
the How-to-fix-it man

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It seems unbelievable—but U. S. fighters are seeing the latest sound movies, with rich, life-like tone quality, projected brilliantly clear right in the middle of the steaming, malaria ridden, insect infested jungles of the Solomons.

The above illustration is based on an actual set-up in New Guinea, one of a chain of theatres in which Red Cross Field Director James Stewart projects the latest sound films to American and Australian front line fighters.

Today, the Special Service units provide each overseas division of the U. S. Army with several complete portable 16 mm. sound projector outfits. Films are rushed to the various fronts via transport planes. In this way, U. S. fighters from the Aleutians to Tunisia, who consider movies as important as food, are thrilled with the cream of America's best and latest motion pictures.

The Ampro Dual Unit here illustrated known as the "J Kit" is standard equipment for Special Service Units. In addition, thousands of Ampro 16 mm. projectors are being used in training men in the Army, Navy and Air Corps. Ampro facilities are engaged



100% in producing projectors and other precision equipment for the U. S. War effort. Ampro engineering is going ahead at full speed. To keep in touch with the latest developments in 16 mm. projection, make certain your name is on the Ampro mailing list. Write today!

AMPRO CORPORATION, 2851 N. Western Ave., Chicago, Ill.

AMPRO

PRECISION CINE EQUIPMENT

Welding for War and Peace

(Continued from page 11)

Already, there is talk of prefabricated all-welded homes to sell complete at \$2,500.

A resort hotel with seven wings and an auditorium seating 1,600 has welded walls, roof and central 100-foot dome.

The War Production Board, in making specifications for the design and erection of structural steel buildings, specified that steel must be saved through effective design and use of welded fabrication.

A power company changed the design of a multi-story switch house from riveted to welded construction to save time, eliminate noise and permit building of later additions without preliminary work.

Results of the Lincoln Foundation's welding program disclosed new applications for welding in every field where metal is used.

In the construction field, all-welded bridges, subways, factory buildings, hotels, churches and homes are in the offing. Welding has been applied to telephone cable ducts and skating rink floors. An all-welded steel gasoline engine for a racing automobile has been designed to save weight and cost and eliminate gaskets. By welding, an automobile frame has been cut down to form a farm tractor. An all-welded fire truck has been designed to accommodate in a 28-foot length equipment that required a truck 62 feet long.

All-welded stoves seem a certainty. Automobiles and refrigerators had many welded parts before their manufacture was halted, but in the future welding will be used far more extensively.

Office equipment and business machines, milling and cutting machinery, containers and tanks, bed springs, busses and bus bodies, even ping pong tables, will employ more welding in their construction, according to forecasts. Use of welding will be broadened considerably in the metal furniture industry. Brazing, a process allied with welding, already is replacing soldering in some industries and one of the country's largest electric motor makers is brazing motor connections with strip phosphor instead of soldering them. This effects a large saving in tin which comprises 48 percent of ordinary solder.

Welding first was used thousands of years ago when fighting men bent over primitive forges to fashion their weapons of war. Egyptian craftsmen worked with crude blowpipes and oil or alcohol flames to fuse trinkets of gold and silver and lead.

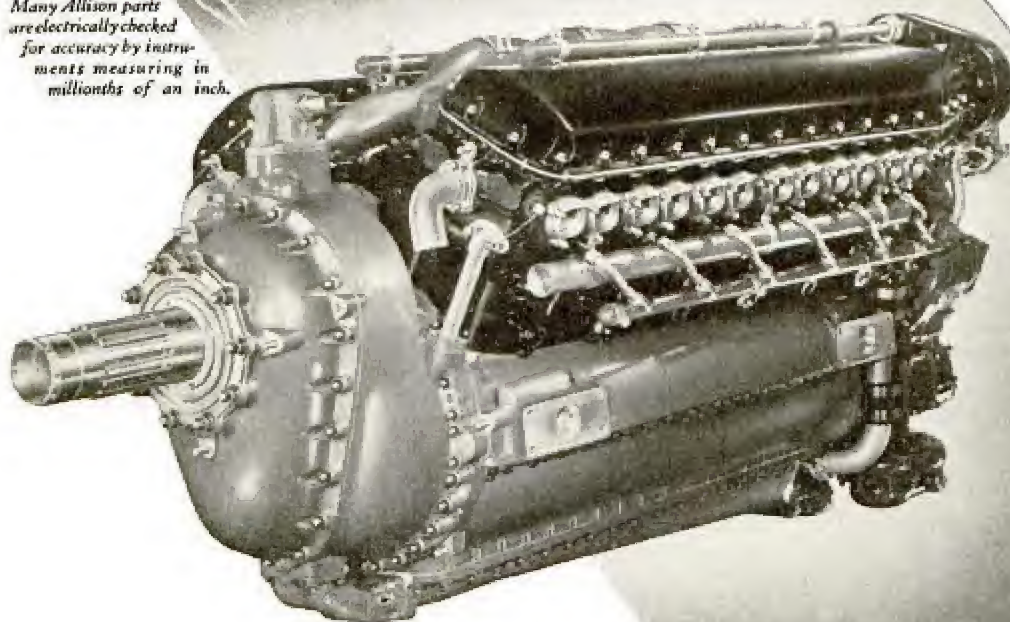
Modern welding has developed most

(Continued to page 168)

ACHIEVEMENT OF A SINGLE PURPOSE

A SINGLE purpose spurred the engineers who planned the Allison engine. ★ A single purpose moves the metallurgists who test and choose the fine materials that go into it. ★ A single purpose guides the skilled hands of the craftsmen who machine and fit its gleaming parts with precision that finds few counterparts in volume production. ★ That purpose is to create the finest aircraft engine ever built. ★ How well that purpose is attained is being written in the records of the planes which the Allison powers—and in the standards it is establishing, at home and abroad, for sturdiness and dependability. ★ Employed in several types of American fighting planes, the Allison is proving before the world the ability of America to work to levels of quality and exactness never before approached.

Many Allison parts are electrically checked for accuracy by instruments measuring in millionths of an inch.



LIQUID-COOLED AIRCRAFT ENGINES

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since 1900, and assumed proportions of the first magnitude only in the last few years.

The two score welding methods in use fall into two broad classifications: the pressure (plastic) processes in which heat is combined with pressure, and the nonpressure or fusion processes.

A third might be added, brazing, in which is used a nonferrous or alloy filler whose melting point is lower than that of the metals joined, but higher than 1,000 degrees F. Since welding itself is an actual mixture of the molecules of the metals joined and a form of cohesion, brazing is something apart, being a form of adhesion.

Five welding methods, with numerous variations, are used in pressure and non-pressure welding, and sometimes in brazing. They are forge, electric arc, gas, resistance, and thermit welding. All but thermit welding have been adapted to processes in which all steps are automatic, eliminating the possibility of human error.

In forge welding, oldest method known, metal pieces are heated in a forge fire and the ends hammered together. Despite improvements in heating furnaces and power forging hammers, the technique is generally too slow and costly for manufacturers, though widely used by blacksmiths and by some railroad shops.

Electric arc welding is one of the two most widely used methods. Metals to be welded are melted by an arc of electric current formed between an electrode handled by the welder and the metal itself, which forms the other electrode.

In gas welding, second of the most widely used methods, the weld is achieved by melting ends of the metals to be welded with the flame from a torch using oxy-acetylene, air-acetylene or other gas.

Resistance welding is the oldest of modern fusion welding methods. Heavy electric current is passed through both pieces to be welded, creating heat through electrical resistance and causing the metals to become plastic. Pressure then is applied much as in forge welding, either manually or mechanically.

Thermit welding is now used extensively where it is necessary to join heavy sections, though formerly used primarily for maintenance or repair. Thermit, a mixture of powdered aluminum and iron oxide, has a reaction which produces a temperature estimated at some 5,000 degrees F. Poured around and between two iron or steel sections prepared in a sand mold, its heat will cause the sections to melt and amalgamate with the thermit steel so that when the entire mass has cooled a homogeneous section is formed.

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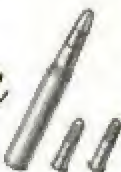


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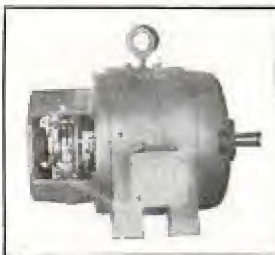
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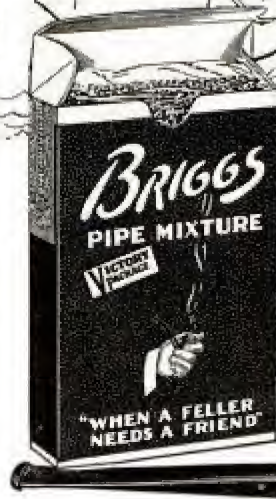
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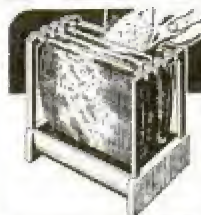
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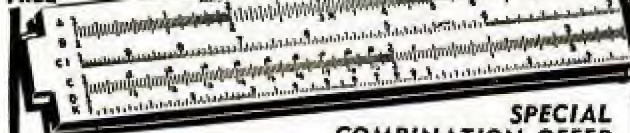
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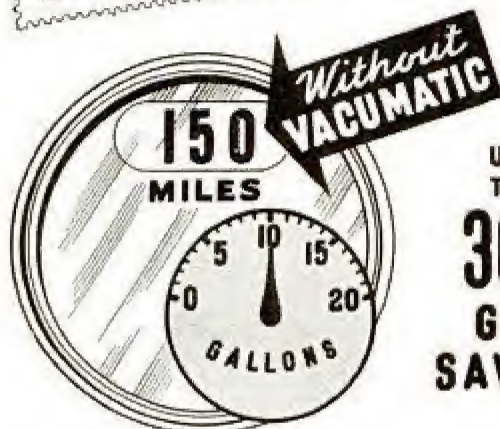
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